Unpacking Entrepreneurial Ecosystem Health: An Entrepreneurial Process Approach

by

Xianwei SHI

Wolfson College

This dissertation is submitted for the degree of

Doctor of Philosophy

At the **University of Cambridge**

Centre for International Manufacturing

Institute for Manufacturing

Engineering Department

University of Cambridge

September 2018

PREFACE

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the Preface and specified in the text. It is not substantially the same as any that I have submitted, or, is being concurrently submitted for a degree or diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the Preface and specified in the text. I further state that no substantial part of my dissertation has already been submitted, or, is being concurrently submitted for any such degree, diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the Preface and specified in the text. It does not exceed the prescribed word limit for the relevant Degree Committee.

Xianwei SHI (石先蔚)

Cambridge
September 2018

Unpacking Entrepreneurial Ecosystem Health: An Entrepreneurial Process Approach

Xianwei Shi

ABSTRACT

What makes an entrepreneurial region stand out among the crowds? On the one hand, regional entrepreneurship literature highlights the impacts of regional context and structures on regional entrepreneurship, but fails to reveal the reciprocity between them, i.e., how regional entrepreneurship could in turn benefit regional context in order to sustain the new venture creation activities over time. On the other hand, although entrepreneurial ecosystem literature provides a new perspective to understand regional entrepreneurship in context by shedding light on the structures and building blocks of an entrepreneurial ecosystem, relatively less is known about what dimensions and factors contribute to the performance and competitiveness that signify the ecosystem's ability to continuously create new ventures in the region. Hence, this research asks: how do we unpack the health of an entrepreneurial ecosystem?

Following an inductive approach, a qualitative study on two exemplary entrepreneurial ecosystems – Silicon Valley, US, and Shenzhen, China – was conducted. For each ecosystem, its evolution over time was revealed first, highlighting critical events and start-ups in different lifecycle stages of the entrepreneurial ecosystem. Then the entrepreneurial processes of key start-ups – Fairchild-Intel, Apple, Google and Tesla in Silicon Valley and Huawei, Tencent and DJI in Shenzhen – as well as their interactions with the ecosystems were analysed. The primary data is mainly from semi-structured interviews with informants pertinent to different players in the ecosystems, as well as employees who are familiar with the entrepreneurial processes of the key companies identified. Primary data was complemented and triangulated with secondary data mainly from academic papers, archives, online articles from reliable sources, books and monographs, as well as biographies of key companies and their founders, etc.

The findings show that entrepreneurial ecosystem health consists of six dimensions: ecosystem resources (supply-side, intermediary, and demand-side resources), entrepreneurial process (resource acquisition in opportunity and organisational creation stages, resource exploitation in organisational creation and technology set-up stages, resource feedback in market exchange and exit stages), ecosystem performance (regional economic impact and regional entrepreneurship performance), ecosystem robustness (resource replenishment and recycling), ecosystem adaptation (resource diversification and exit), and enabling conditions for resource dynamisms (three sets of conditions for resource replenishment and recycling, for resource diversification, as well as for resource exit, respectively). This dissertation also sheds light on how resource acquisition, exploitation and feedback in individual entrepreneurial processes contribute to the resource dynamisms in entrepreneurial ecosystems. With these health dimensions and resource dynamisms, an integrated process model revealing how a healthy entrepreneurial ecosystem continuously creates new ventures is provided. It is argued that, from the entrepreneurial process perspective, the health of an entrepreneurial ecosystem divulges its current performance in relation to new venture creation and the expectation of whether its ability to continuously create new ventures will be sustained or even grow.

This dissertation seeks to contribute to entrepreneurial ecosystem literature with the conceptualisation of entrepreneurial ecosystem health. The resource dynamisms bridge the gap between individual entrepreneurs and entrepreneurial ecosystems and shed light on how resource-accessing behaviours in individual entrepreneurial processes contribute to the ecosystem-level resource dynamisms. The integrative process model contributes to the regional entrepreneurship literature by elaborating on the feedback impacts of regional entrepreneurship on regional resources. Finally, a resource-based view of entrepreneurial ecosystems is provided, which addresses the necessity of facilitating sufficient resource dynamisms within and outside of the ecosystems *in pursuit of ecosystem health*. This dissertation has implications for governments to guide their policy initiatives by informing them of the health of their regional entrepreneurial ecosystems in order to maximise the economic return and societal utilities. It also has implications for individual entrepreneurs in terms of their location choices and how to leverage resources of the ecosystem in which they reside.

ACKNOWLEDGEMENTS

First, I would like to express my sincere gratitude to my supervisor, Dr Yongjiang Shi, who has mentored, guided and encouraged me throughout this four-year PhD journey. I will forever remember the days when we were discussing ecosystems, and the nights when I was struggling with my research. He has taught me how to conduct independent research, and also what it means to be a teacher. Without Shi Laoshi, this dissertation, along with my ambitions of pursuing an academic career, will never be possible.

I would also like to thank colleagues in the Institute for Manufacturing, in particular Yuankun Luo, Hyunkyu Park and Xingkun Liang, who have kindly supported me, as friends and as co-authors. I am also grateful for the support from my interviewees, who contributed their valuable time to this research and provided me with insightful stories on Silicon Valley, Shenzhen and beyond. I would also like to thank Cambridge Trust and China Scholarship Council for their financial support.

My special thanks go to my beloved family. My parents, Shaoping Shi and Qinghong Zhou, who I am deeply indebted to, have encouraged me throughout these years. Without their understanding and support, this dissertation could not have been completed. I am also extremely grateful to my life-long partner, Mingjin Guo, who is always by my side unconditionally. I know how lucky I am to have met you back in Tsinghua. I will always remember our Cambridge days and how you have inspired me again and again.

Finally, I would like to thank the (future) readers of this dissertation, although I suspect there will not be many. When you are reading this, you may understand the efforts I have put in this dissertation, and the countless nights that I spent in solitary, contemplating how to write the next few sentences. I hope you may also come to realise (eventually, just like I did) how painful, yet luxury and enjoyable it can be, to do a PhD.

Table of Contents

List of Tables

List of Figures

1. Introduction

1.1 Research background

As entrepreneurship and new venture creation have become important sources of economic growth and essential lubricants for regional development in recent years (Benneworth, 2004), discussions around entrepreneurship and regional development have become popular among academics, policymakers and industry practitioners. In developed economies such as the United States, regions like Silicon Valley (Saxenian, 1996) and the Greater Boston Area (Best, 2014) have grown to the poplars of global entrepreneurship and innovation since WWII. In Europe, Cambridge, UK (Garnsey, Lorenzoni, and Ferriani, 2008), also known as 'Silicon Fen', has gained considerable attentions in terms of research and technology enabled entrepreneurship. The successful stories of these entrepreneurial regions make one wonder why and how they have gained their triumph, and whether their success could be replicated elsewhere. Indeed, interests among policy makers and industry practitioners have burgeoned over the past twenty years in terms of monitoring regional entrepreneurship[1] and promoting regional development. For example, many developing countries have issued policies to foster new venture creation activities[2], such as the Chinese government's 'Mass Innovation and Entrepreneurship'[3] in order to boost regional economic growth. Over the past few years, prominent regions like Beijing, Shenzhen, Hangzhou and Shanghai have become the central locus of new venture creation activities in China: impactful start-ups including Tencent, Alibaba, and Baidu have changed lives of normal Chinese people dramatically.

However, a fundamental question that challenges policy makers and industry practitioners is

[1] Such as the Global Entrepreneurship Monitor (GEM) project: https://www.gemconsortium.org

[2] http://www.oecd.org/sdd/business-stats/entrepreneurship-at-a-glance-22266941.htm

[3] https://www.ft.com/content/11aed256-1209-11e6-91da-096d89bd2173

that why some regions stand out in terms of new venture creation among the many regions within and outside their own countries. Specifically, what are the key factors that contribute to their success and what could be the underlying mechanisms for their sustained performance of new venture creation over the years? Answers to these questions bear enormous implications for regional and national governments to issue appropriate policies for promoting regional entrepreneurship and economic development.

On the academic side, extant research suggests that munificent regional structures and contexts precipitates regional entrepreneurship (Müller, 2016). These regional structures and contexts could include different resources required by entrepreneurs to fulfil their entrepreneurial journeys, such as financial, knowledge, and human capitals, infrastructures, local value chains and research institutes etc. Indeed, scholars have come to realise that entrepreneurs do not create their ventures in a vacuum (Van De Ven, 1993). Rather, new venture creation activities are deeply embedded within and enabled by the regional socio-economic systems, and new venture creation activities could in turn alter the existing regional structures. A system perspective is therefore needed to understand the reciprocity between entrepreneurship and regional development. Early efforts in outlining such reciprocity include the infrastructure of entrepreneurship (Van De Ven, 1993) and entrepreneurship systems (Spilling, 1996).

The concept of entrepreneurial ecosystem, which emerged with a strong policy flavour (Isenberg, 2011), describes the regional communities consisting of multiple interdependent and co-evolving actors involved in the new venture creation processes (Autio *et al.*, 2018; Cohen, 2006; Mack and Mayer, 2015; Spigel, 2017). Such a regional entrepreneurial ecosystem consists of various domains that facilitate new venture creation and also evolves over time (Isenberg, 2011; Mack and Mayer, 2015). Over the past few years, the ecosystem construct has become a new lens to examine regional entrepreneurship (Brown and Mason, 2017). Despite the flourish of regional entrepreneurship literature, significant gaps remain in the emerging entrepreneurial ecosystem literature, and these gaps provide opportunities to further explore the reciprocity between entrepreneurship and regional development, as well as the heterogeneities in regional entrepreneurship.

Firstly, research has been surprisingly scarce on the performance or competitiveness of an entrepreneurial ecosystem. Although numerous literature on business ecosystems and clusters has raised the importance of maintaining a healthy ecosystem/cluster for all players involved (Iansiti and Levien, 2004a; Porter, 2000), the critical dimensions for the ecosystem to sustain new venture creation continuously over time still remain ambiguous. Differing from previous literature on performance and determinants of regional entrepreneurships (Davidsson, 1991), this dissertation is not looking for traditional performance indicators for the health of entrepreneurial ecosystems, as doing so will undermine the novelty of the concept.

Secondly, although some research has focused on ecosystem lifecycle (Mack and Mayer, 2015), ecosystem process (Spigel and Harrison, 2018), and ecosystem structural models (Autio *et al.*, 2018), more insights on how entrepreneurial ecosystems evolve, and especially how ecosystems co-evolve with actors as well as the resultant implications, can be offered via further empirical research (Acs *et al.*, 2017).

Thirdly, the reciprocity of entrepreneurial ecosystems and ecosystem actors is not fully understood. Although extant literature has demonstrated how regional resources precipitate regional entrepreneurship, relatively less is known about whether and how regional entrepreneurship, in turn, benefits regional resources and contexts (Müller, 2016).

Finally, extant research has shed less light on how individual entrepreneurs are relevant in entrepreneurial ecosystems. As entrepreneurs' activities may well change the ecosystem (Thompson, Purdy, and Ventresca, 2018) collectively, examining the health of entrepreneurial ecosystems from an entrepreneurial process perspective may offer opportunities to reveal the underlying mechanisms.

1.2 Research question and objectives

With the above practical and theoretical motivations, this dissertation sets out to answer the following question:

How do we unpack the concept of entrepreneurial ecosystem health from an entrepreneurial process perspective?

To answer the overarching research question, this dissertation is aimed at:

- Identifying the key dimensions that constitute entrepreneurial ecosystem health
- Identifying the resource dynamisms underlying the entrepreneurial ecosystems and their linkages to micro entrepreneurial processes
- Understanding how a healthy entrepreneurial ecosystem durably facilitates new venture creation over time

1.3 Dissertation structure

As is shown in Figure 1-1, this dissertation is structured as follows:

Chapter 2 introduces key interdisciplinary linkages and antecedents for entrepreneurial ecosystems, and regional entrepreneurship literature, as well as the related concepts of 'health' in various domains. Research gaps and research questions are identified at the end of the literature review.

In Chapter 3, research design employing a multiple embedded case design is adopted, with two levels of unit of analysis being ecosystem-level and entrepreneurial firm-level. Silicon Valley and Shenzhen have been selected as the case regions and their respective entrepreneurial firms in different time frames have also been identified. Primary data including site visits and interviews with key informants in both regions, and secondary data including books, websites and biographies etc. were used in the analysis. It also introduces how this dissertation has combined process data analysis, inductive coding and cross-case analysis.

In Chapter 4, the evolution of Shenzhen and Silicon Valley entrepreneurial ecosystems is described, as well as key companies' entrepreneurial processes and their interactions with the ecosystems.

Chapter 5 identifies six dimensions: ecosystem resources, entrepreneurial process, ecosystem performance, ecosystem robustness, ecosystem adaptation, and enabling conditions for resource dynamisms, answering to the first sub research question ‘what are the dimensions for entrepreneurial ecosystem health’

Chapter 6 serves to answer the second sub research question ‘How do individual entrepreneurial activities contribute to collective entrepreneurial ecosystem health’, by identifying the underlying relationships between individual level resource accessing behaviours and the ecosystem level resource dynamisms.

Chapter 7 integrates findings from Chapter 5 and 6, and explicates a process model to answer the third sub research question ‘How does a healthy entrepreneurial ecosystem facilitate new venture creation’. The process model presents a closed loop that details how a healthy entrepreneurial ecosystem could durably facilitate new venture creation even upon external disruption. A formal definition of entrepreneurial ecosystem health taking a dynamic and process perspective is proposed.

Chapter 8 discusses how this dissertation contributes to entrepreneurial ecosystem literature and regional entrepreneurship literature. Practical implications for entrepreneurs and policymakers, as well as research limitations and future research opportunities are provided.

Chapter 9 presents a concise summary for the dissertation regarding research background, method, findings, contributions, limitations and future research.

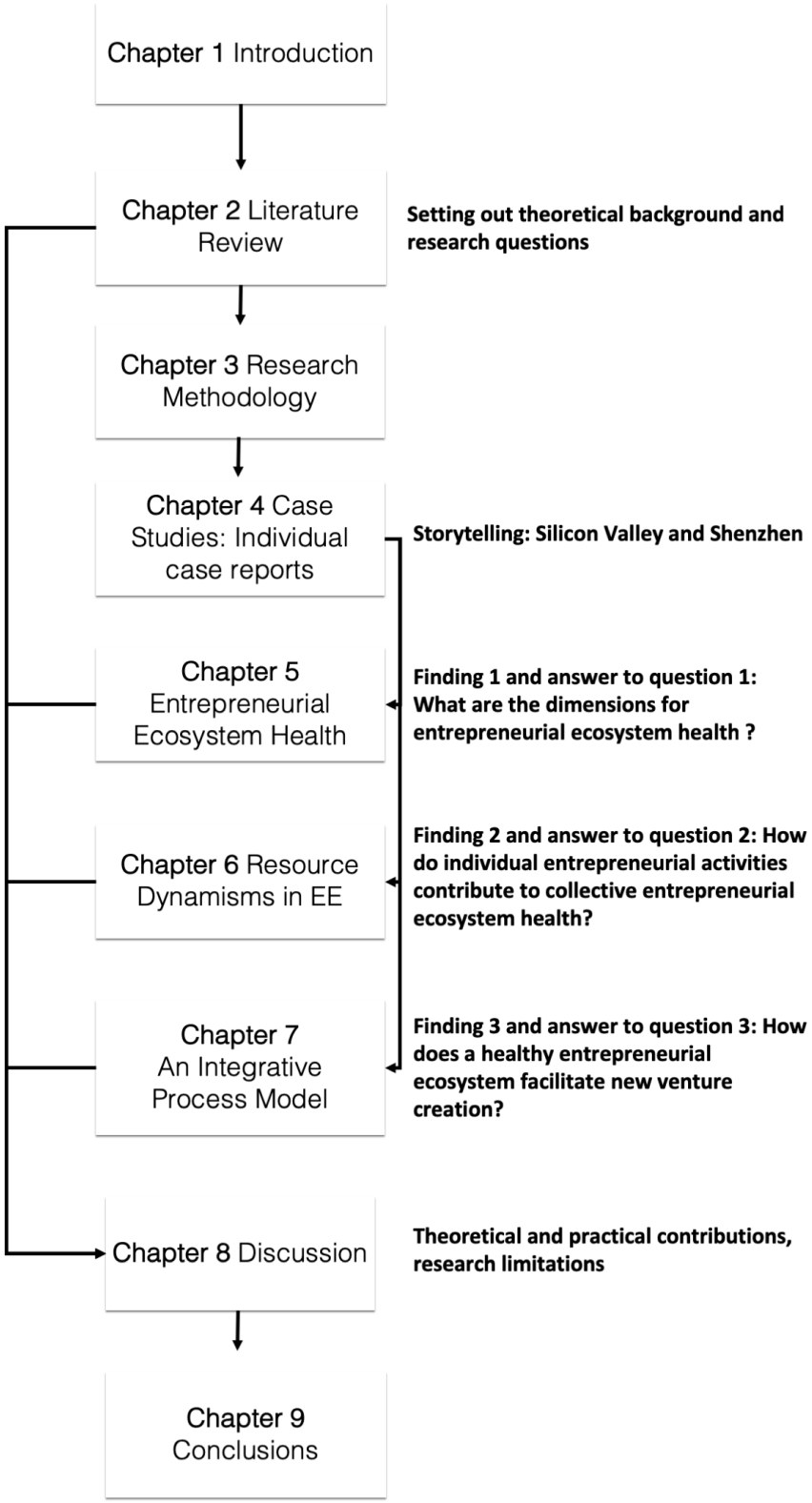


Figure 1–1 Dissertation structure

2. Literature Review

2.1 Introduction

In this chapter, the literature on the geographical focus of entrepreneurship and the emerging domain of entrepreneurial ecosystems is first introduced. Then the interdisciplinary linkages and antecedents to entrepreneurial ecosystems are revealed, followed by a discussion of the use of 'health' in various domains. This chapter is concluded by highlighting research gaps identified from the literature review and the research question of this dissertation.

2.2 Geographies of entrepreneurship

Entrepreneurs do not create new ventures in a vacuum. Traditional cognitive-based entrepreneurship literature has revealed some of the intrinsic entrepreneurial traits in identifying opportunities and creating new ventures, but the influences of external environments on their entrepreneurial processes (Gartner, 1990; Mason and Harvey, 2013) are not well explained and delineated. As a result, scholars have come to realise that there is a need to promote the geographical dimensions of entrepreneurship, highlighting the antecedents and outcomes of entrepreneurship in relation to regional factors and contexts (Müller, 2016).

2.2.1 Entrepreneurship and regional development

It has been well explained in regional entrepreneurship literature that entrepreneurial activities could contribute to regional development. Scholars argue that new venture creation activities encouraged by policymakers could help shape a growth regime focusing primarily on new venture creations and therefore foster regional development by creating jobs and wealth, although this is certainly not the only approach for regional development (Audretsch and Fritsch, 2002). Some scholars also view the flourishing entrepreneurial activities as an important indicator for regional development (Pike, Rodríguez-Pose, and Tomaney, 2007).

Nevertheless, extant literature acknowledges the positive impacts of entrepreneurship over regional development, and these impacts mainly include economic impacts and social impacts (Müller, 2016).

In terms of regional economic impacts brought by regional entrepreneurship, empirical work mainly focuses on measurements such as job creation and employment growth, as well as GDP growth and productivity growth. For example, Acs and Armington (2004) find that entrepreneurial activities as externalities have a positive impact on employment growth. Overall economic growth measured by job creation and GDP growth is also found to be positively associated with the extent of new venture creation activities in the region (Bruce *et al.*, 2009). Audretsch and Keilbach (2004) further argue that entrepreneurship is an important mechanism in driving the diversity of a region's knowledge base, which in turn boosts the labour productivity growth.

Despite the fact that previous research focuses more on the debate around the positive impacts of regional development on regional entrepreneurship, it is intuitive to ask whether there exists reciprocity between the two, i.e., whether regional development has a positive impact on regional entrepreneurship. Delgado, Porter and Stern (2010) argue that the presence of complementary economics realised by regional clustering provides incentives and reduces barriers for new venture creation within a region. Surely, entrepreneurs are highly embedded into the regional contexts they operate within, and mobilise resources and institutions in the region in order to create and develop their new ventures (Mason and Brown, 2014). However, extant research has yet to fully understand the geographical and regional approaches to entrepreneurship, leaving spaces to explore the boundary conditions and underlying mechanisms of the reciprocity of regional entrepreneurship and regional development.

2.2.2 Entrepreneurial systems

As scholars gradually came to realise that a system view of entrepreneurship (Qian, Acs, and Stough, 2013) could offer new insights on how external environments influence entrepreneurial

process and performance, infrastructures of entrepreneurship (Van de Ven 1993) were proposed. Both Qian et al. (2013) and Van de Ven (1993) argue that an individual entrepreneur's behaviours and characteristics are to some extent bounded by different actors and players in the specific locality in which that entrepreneur has embedded themselves. Van de Ven (1993) specifically addresses the need to take a macro perspective to examine entrepreneurial process and the industrial infrastructure that the focal region offers to facilitate (or constrain) new venture creation activities (Zahra, 2016). Fogel and Gnyawali (1994) have further identified four environmental conditions that influence entrepreneurial processes: government policies, financial and non-financial support, socio-economic conditions and entrepreneurial skills.

Spilling (1996), instead of considering the micro impacts of environmental conditions on entrepreneurial processes, proposed a system view of entrepreneurship, to examine the region or locality as a system that brings together multiple interacting actors determining the performance of regional entrepreneurship, as is illustrated in Figure 2-1. Further research has identified some of the most prominent components or factors that enable new venture creation in an entrepreneurship system, such as the entrepreneurial culture, incubators and spin-offs, etc. (Neck *et al.*, 2004).

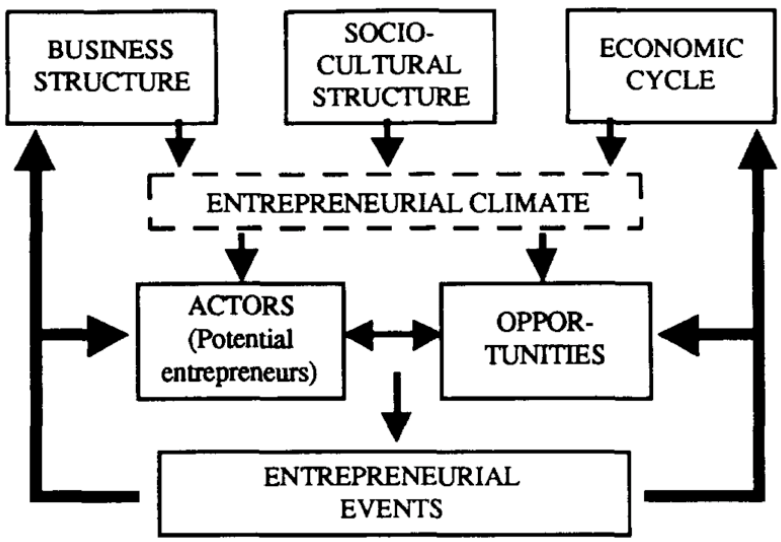


Figure 2–1 Spilling's (1996) model of entrepreneurial systems

2.2.3 Entrepreneurial networks

The earliest entrepreneurship research focused on the combination of resources and new venture creation as outcomes (Roberts, 2001; Schumpeter, 1934). Then, scholars highlighted differences of cognitive and behavioural factors of entrepreneurs (Baron, 2007) and their impacts on the identification and exploitation of business opportunities and resources (Shane and Venkataraman, 2000). Subsequent research found that entrepreneurs had to acquire capability to coordinate the networked resources. Regarding the network issues of entrepreneurship, which emerged as a new area in recent years, network content, network governance and network structure (Hoang and Antoncic, 2003) have become the central themes that uncover the myths of how entrepreneurial networks affect the process and performance of entrepreneurial outcomes.

While the network content addresses how actors exchange or access tangible resources within the social networks (Anderson, Park, and Jack, 2007; Birley, 1985; Rindova *et al.*, 2012), it is also found that intangible resources such as emotional support (Brüderl and Preisendörfer, 1998) and reputational signalling (Stuart and Hybels, 1999) will alleviate the risks or perception of risks undertaken during the entrepreneurial processes (Hoang and Yi, 2015). Literature regarding network governance has identified trust as a vital element that facilitates the information and resource exchanging process (Larson, 1992; Lorenzoni and Lipparini, 1999; Wareham, Fox, and Cano Giner, 2014). The third stream, i.e. the network structure, focuses on the patterns of relationships, including indirect and direct ties between actors within the networks (Hoang and Yi, 2015). In order to reveal the structures of entrepreneurial networks, researchers have measured the network size (Vissa & Chacar 2009), network centrality (Jonghoon et al. 2011) and network density (Krackhardt, 1995).

Although the entrepreneurial networks do not necessarily address the geographical dimensions of entrepreneurship, such entrepreneurial networks are often specially bounded, as information spillovers and network tie formation are often coupled with easily accessible entrepreneurial networks within a certain region. Therefore, the entrepreneurial network approach provides a

useful perspective for understanding regional dynamics of entrepreneurship.

2.2.4 Towards entrepreneurial ecosystems

The entrepreneurial ecosystem concept was first proposed by Cohen (2006), building upon entrepreneurial systems (Spilling, 1996) and infrastructure (Van De Ven, 1993) as well as business ecosystem (Iansiti and Levien, 2004a) literature to describe a community consisting of various components such as formal and informal networks, physical infrastructure and culture that enables the creation and development of a sustainable entrepreneurial ecosystem. Since then, entrepreneurial ecosystem publications have burgeoned, as scholars come to realise that the new entrepreneurial ecosystem concept could potentially provide a new lens to study entrepreneurship in relation to the external environment. The key publications of entrepreneurial ecosystems primarily from leading (ABS 3 and 4) journals, since 1996, are listed in Table 2-1.

The current entrepreneurial ecosystem research is categorised into three streams: *ecosystem structures* that identify the main components and roles in an entrepreneurial ecosystem and how they interact with each other; *ecosystem/actor reciprocity* that sheds light on how entrepreneurial ecosystems and the actors co-create value and the resultant mutual impacts; and *ecosystem dynamics* that reveal how entrepreneurial ecosystems emerge, evolve and decline/renew over time.

The first stream addresses the **ecosystem structures** – the main roles that constitute an entrepreneurial ecosystem and how these roles interact with each other. This stream represents some of the early entrepreneurial ecosystem literature, such as Cohen (2006), who refers to entrepreneurial ecosystems as communities that consist of various components, and Isenberg (2011), who has identified six domains of entrepreneurship ecosystems, policy, finance, culture, supports, human capital and markets, as is shown in Figure 2-2. Further work by Spigel (2017) argues that an entrepreneurial ecosystem has three intrinsic attributes – material attributes consisting of policies, universities, infrastructure, markets and supporting services, social

attributes including networks, talents, mentors and role models, and investment capital, as well as cultural attributes such as entrepreneurial culture and histories, as is shown in Figure 2-3 below. Further work by Autio et al. (2018) proposes a structural model of entrepreneurial ecosystems, highlighting the digital and spatial affordances provided by the region as well as their implications for the goals, processes and contingencies to the ecosystems, as is illustrated in Figure 2-4. As the foundational stream, this series of research underpins the criticality of entrepreneurial ecosystems in the broad entrepreneurship and regional development domains (Groth, Esposito, and Tse, 2015).

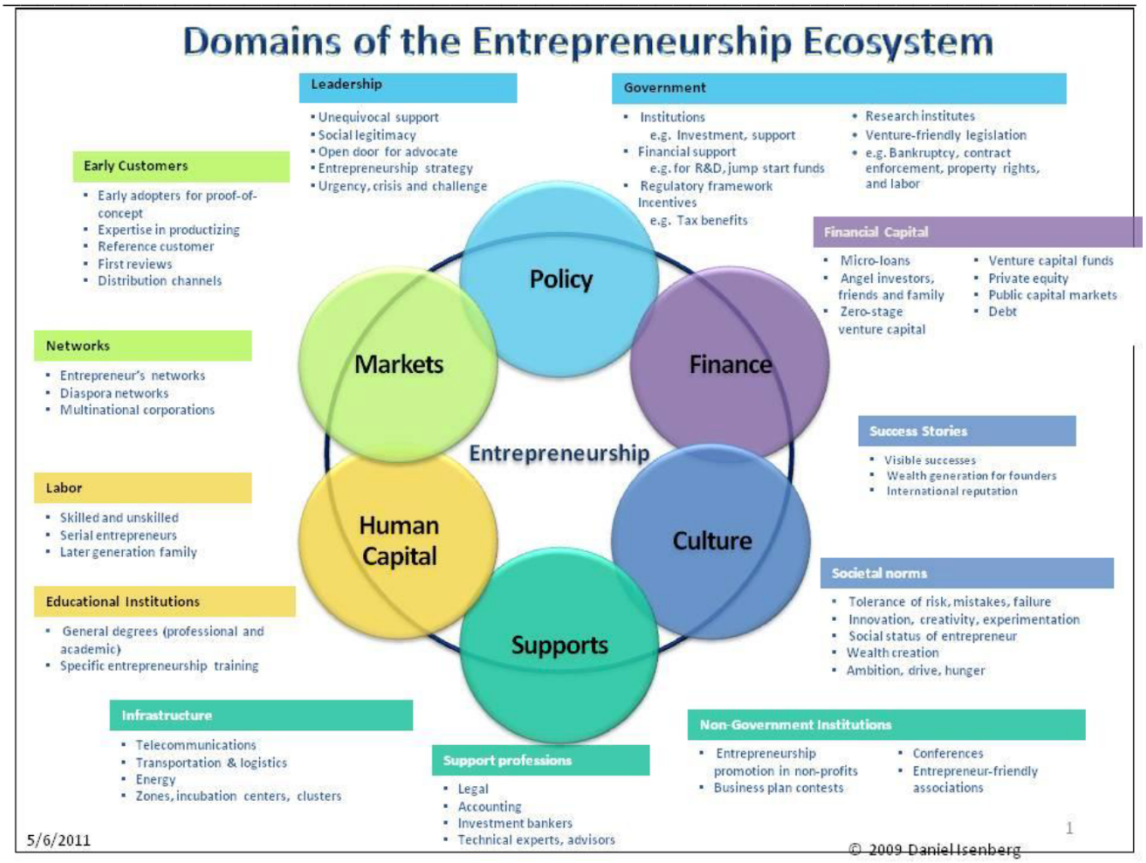


Figure 2–2 Domains of the entrepreneurship ecosystem (Isenberg, 2011)

The second stream addresses the **ecosystem/actor reciprocity** that highlights the interactions and mutual impacts between an entrepreneurial ecosystem and its actors. This stream started with the discussion of entrepreneurship in an ecosystem context (Nambisan and Baron, 2013; Zahra and Nambisan, 2012), where an ecosystem's impacts on entrepreneurs include the

necessity of pursuing multiple goals due to the complexity of ecosystem competition as well as the demand of recognising promising growth opportunities within and outside of an ecosystem (Nambisan and Baron, 2013). Further work examines the reciprocity between entrepreneurial ecosystems and actors, for example, how entrepreneurs legitimise their new ventures within an entrepreneurial ecosystem (Kuratko *et al.*, 2017), and how accelerators intermediate between entrepreneurs and entrepreneurial ecosystems (Goswami, Mitchell, and Bhagavatula, 2018), as well as the conditions under which entrepreneurial ecosystems can be strengthened in a city (Audretsch and Belitski, 2016).

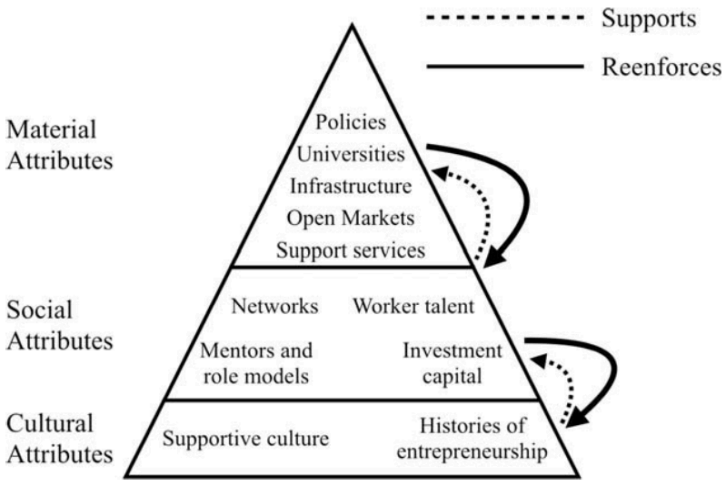


Figure 2–3 Relationship among ecosystem attributes (Spigel, 2017)

The third stream examines the **ecosystem dynamics** that shed light on how entrepreneurial ecosystems as well as the embedded actors emerge, develop and evolve over time (Brown and Mason, 2017). Scholars have noted the dynamic (Alvedalen and Boschma, 2017) and temporal (Acs *et al.*, 2017) nature of entrepreneurial ecosystems and therefore advocate adopting an evolutionary perspective (Mack and Mayer, 2015). Autio *et al.* (2018) also argue that the internal processes and mechanisms of entrepreneurial ecosystems have yet to be fully understood. Scholars further adopt a life cycle assessment on entrepreneurial ecosystem vibrancy and its developmental path (Auerswald and Dani, 2017). Studies in this stream include the exploration of entrepreneurial ecosystem emergence. For example, how clusters act as the foundations of the emergence of entrepreneurial ecosystems as well as ecosystem value

creation (Pitelis, 2012), and also how an entrepreneurial ecosystem takes form from the bottom up in a long process involving multiple actors (Thompson *et al.*, 2018). Such dynamics are not limited to processes and mechanisms within entrepreneurial ecosystems; they also include the system evolution, as Spigel and Harrison (2018) point out that it is important to not only examine ecosystem processes but also the ecosystem as a process.

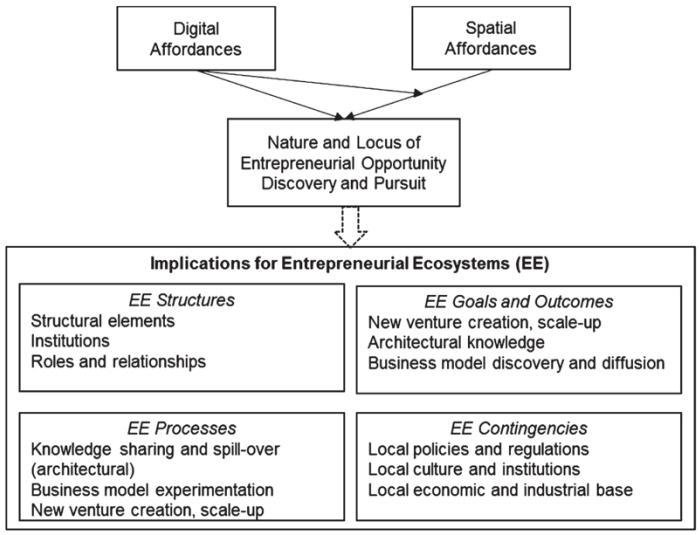


Figure 2–4 Structural model of entrepreneurial ecosystems (Autio *et al.*, 2018)

It can be seen from the above three streams that extant entrepreneurial ecosystem literature focuses more on structures and configurations of ecosystems (Cohen, 2006; Nambisan and Baron, 2013; Qian *et al.*, 2013; Spigel, 2017), with considerable room to explore the dynamics of an entrepreneurial ecosystem as well as its impacts on ecosystem actors over time (Alvedalen and Boschma, 2017; Spigel and Harrison, 2018). What is equally surprising is that there is very little research concerned with the performance and competitiveness of an entrepreneurial ecosystem, though it has been frequently acknowledged that the health of the whole ecosystem (Shi and Shi, 2016, 2017) is crucial to all the actors involved (Iansiti and Levien, 2004a; Iansiti and Richards, 2006).

Table 2–1 A summary of definitions of the term entrepreneurial ecosystem and its related concepts

Year	Author	Definition of Entrepreneurial Ecosystem & its Related Concepts	Defining Keywords & Phrases	Case Regions & Industries
1993	Van de Ven	Infrastructure for entrepreneurship: an industrial infrastructure that facilitates and constrains entrepreneurship. This infrastructure includes: (1) institutional arrangements to legitimate, regulate and standardise a new technology, (2) public resource endowments of basic scientific knowledge, financing mechanism and a pool of competent labour, as well as (3) proprietary R&D, manufacturing, marketing and distribution functions by private entrepreneurial firms to commercialise the innovation for profit.	Infrastructure, institutional, resources, entrepreneurial firms.	N/A. Conceptual paper
1996	Spilling	Entrepreneurial system: the complexity and diversity of actors, roles and environmental factors that interact to determine the entrepreneurial performance of a region or locality.	Interact, entrepreneurial performance, region	Lillehammer, Norway/Multiple sectors related to Olympics: Hotels, Tourism, Souvenirs
2004	Neck, Meyer, Cohen and Corbett	Based on Spilling's definition: an entrepreneurial system: encompasses the complexity and diversity of actors, roles and environmental factors that interact to determine the entrepreneurial performance of a region or locality.	Interact, entrepreneurial performance, region	N/A. Conceptual paper
2005	West and Bamford	Entrepreneurial economic community: generates new employment, leads to a growing tax revenue base, enhances prospects for self-generating innovation and future growth, and yields qualitative improvements to an area's economic vitality.	Community, economic development, innovation	Finance. IT and Retail industries
2006	Cohen	Entrepreneurial ecosystems represent a diverse set of inter-dependent actors within a geographic region that influence the formation and eventual trajectory of the entire group of actors and potentially the economy as a whole. Entrepreneurial ecosystems evolve through a set of interdependent components which interact to generate new venture creation over time.	Interdependent, geographical region, new venture creation	Victoria, British Columbia. General high-tech
2011	Zahra and Nambisan	Entrepreneurship in an ecosystem takes forms that include creating new companies, establishing new divisions that capitalise on technological change, and introducing radically new products and business models. The reciprocal relationships among the ecosystem, new venture creation and innovation perpetuate the dynamism of the ecosystem.	New venture creation, dynamism, reciprocal relationships	N/A. Conceptual paper
2011	Isenberg	Entrepreneurial ecosystems contain six domains: policy, finance, culture, supports, human	Entrepreneurship as a process, reciprocity,	N/A. Conceptual

		capital and markets.	domains	paper
2013	Qian, Zoltan and Stough	Systems of entrepreneurship: those economic, social, institutional and all other important factors that interactively influence the creation, discovery and exploitation of entrepreneurial opportunities.	Factors, entrepreneurial opportunities	High-Tech industries
2015	Groth, Esposito and Tse	Entrepreneur-driven innovation ecosystem: a system that pairs austerity with well-focused spending on a new, structurally sound model for sustainable growth that will initially tackle financial deficits and ultimately create financial stability and act as a motor to pull Europe through future crises.	Sustainable growth, financial, motor	N/A. Conceptual paper
2015	Spigel	Entrepreneurial ecosystems are the union of localised cultural outlooks, social networks, investment capital, universities and active economic policies that create environments supportive of innovation-based ventures.	Social, material and cultural attributes, new venture creation	Waterloo and Calgary, Canada/General high-tech
2015	Mack and Mayer	Entrepreneurial ecosystems (EE) consist of interacting components, which foster new firm formation and associated regional entrepreneurial activities.	Interacting, regional entrepreneurship	Phoenix, Arizona, US. General high-tech
2016	Audretsch and Belitski	Institutional and organisational as well as other systemic factors that interact and influence identification and commercialisation of entrepreneurial opportunities.	Factors, interact, influence, entrepreneurial opportunities	A sample of 70 European cities. Information technology and Internet
2017	Alvedalen and Boschma	N/A	Lack of analytical framework, static, performance, and comparative perspective	N/A. Literature review/Conceptual paper
2017	Sussan and Acs	The Digital Entrepreneurial Ecosystem framework consists of four concepts: digital infrastructure governance, digital user citizenship, digital entrepreneurship and digital marketplace.	Digital entrepreneurial ecosystem, digital entrepreneurship	N/A. Literature review/Conceptual paper
2017	Kuratko, Fisher, Bloodgood	A set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship.	Legitimacy in entrepreneurial ecosystem; Newness	N/A. Literature review/Conceptual paper

	and Hornsby			
2017	Acs, Stam and Audretsch	The entrepreneurial ecosystem approach emphasises the interdependence between actors and factors, but sees entrepreneurship (new value creation by agents) as the output of the entrepreneurial ecosystem.	Regional development, publicly oriented, interdependence	N/A. Literature review/Conceptual paper
2017	Auerswald and Dani	Entrepreneurial ecosystems are evolutionary, and the evolution of an entrepreneurial ecosystem has a determinative impact on the adaptive life cycles of industry clusters embedded within the ecosystem.	Clusters, evolutionary economics, biotech	National Capital Region, US. Biotech industry
2018	Autio, Nambisan, Thomas and Wright	Entrepreneurial ecosystems can be usefully viewed as structures that specialise in the facilitation and cultivation of a specific type of architectural knowledge – notably, knowledge about 'what works' in terms of organising for business model innovation and entrepreneurial opportunity pursuit and scale-up.	Digital and spatial affordances, special cluster type, structural model	N/A. Literature review/Conceptual paper
2018	Goswami, Mitchell and Bhagavatula	N/A	Accelerators, ecosystem intermediation, entrepreneurial expertise	Bangalore, India. General high-tech
2018	Thompson, Purdy and Ventresca	N/A	Entrepreneurial ecosystem emergence, entrepreneurial behaviours	Seattle, US. Social entrepreneurship
2018	Theodoraki, Messeghem and Rice	Entrepreneurial ecosystems possess three social capital dimensions, namely structural, cognitive and relational dimensions, and these dimensions interact with one another to increase performance of the ecosystem	Social capital, incubators, and entrepreneurial support	France. Business incubators
2018	Spigel and Harrison	A process-based perspective to create a framework to better understand how ecosystems develop, evolve and deliver benefits to entrepreneurs. It is important to understand how resources flow within the ecosystem, how they are produced by internal mechanisms such as recycling of both successful and unsuccessful ventures, and how they can also be attracted into the ecosystem by the global pipelines entrepreneurs create.	Process, resource flow, comparisons between entrepreneurial ecosystems, regional innovation systems, and clusters	N/A. Conceptual paper

2.3 Interdisciplinary linkages and antecedents to entrepreneurial ecosystems

The emergence of the entrepreneurial ecosystem in the entrepreneurship literature could potentially provide a new lens to study entrepreneurship in relation to the external environment. This concept, however, draws on a few interdisciplinary concepts and antecedents in adjacent domains such as biology, strategy and regional economics. These concepts are reviewed in this section and their differences are also highlighted.

2.3.1 Biological ecosystems

The word 'ecosystem' was first proposed by Tansley (1935), after which it was widely accepted as the description of a community of living organisms in conjunction with the non-living components of their environment and that they are interacting as a system. Discussions around biological ecosystems focus on the ecosystem functions and services.

Ecosystem functions is usually discussed along with the discussion of biodiversity (Goldstein and Goldstein, 1999; Grime, 1997), which refers to the diversity of genes and species, etc. When discussing biodiversity, current researches have three different major questions, which involve different usages of the term 'functions' (Jax and Setälä, 2005).

The first question is how ecosystem biodiversity relates to ecosystem functions. In this case, function means processes, which normally include a wide range of ecological and physical processes that involve flux of energy and matter (Jax and Setälä, 2005). This stream of research focuses on exploring whether increasing biodiversity will have impacts on certain ecosystem processes such as biomass production and litter decompositions.

Another question is to explore how biodiversity relates to the functioning of ecosystems. Here, functioning is a collective set of activities within the whole ecosystem and can sometimes be referring to the performance of the ecosystem (Risser, 1995; Schulze and Mooney, 1994). In

this scenario, ecosystem functions are more focused on exploring the minimum number of species or the lowest amount of biodiversity required for an ecosystem to function properly (Jax and Setälä, 2005).

Another stream of ecosystem functions considers this concept to be similar to, and sometimes even equal to, ecosystem services. The concept of ecosystem services emerged in the area of biological conservation and ecosystem management as early as the 1980s. As mentioned above, it has been closely associated with ecosystem functions. A systemic classification of ecosystem services indicates that there are four types of functions, regulation, habitat, production and information, and they will deliver ecosystem services that eventually provide ecological, socio-cultural and economic values to the society (De Groot, Wilson, and Boumans, 2002). Here, the boundaries of functions and services are becoming blurred. This framework is shown in Figure 2-5.

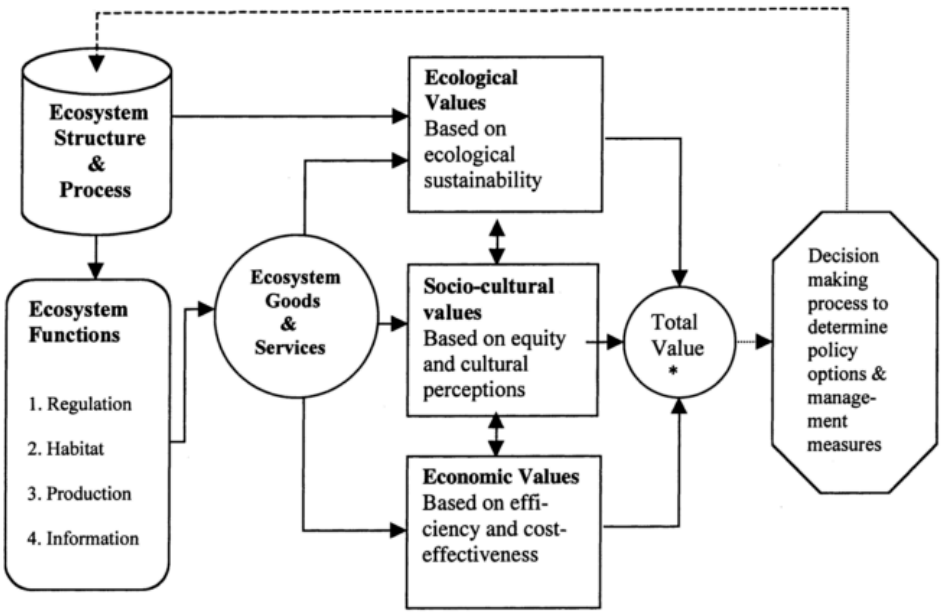


Figure 2–5 Framework for integrated assessment and valuation of ecosystem functions, goods and services (De Groot *et al.*, 2002)

The term ecosystem services was formalised and popularised by the United Nations in a report, where it is defined as "the benefits provided by ecosystems", comprising provisioning, regulating, cultural and supporting services, and these services are considered to be closely

related to human well-being (Millennium Ecosystem Assessment 2005, p.39), as is illustrated in Figure 2-6.

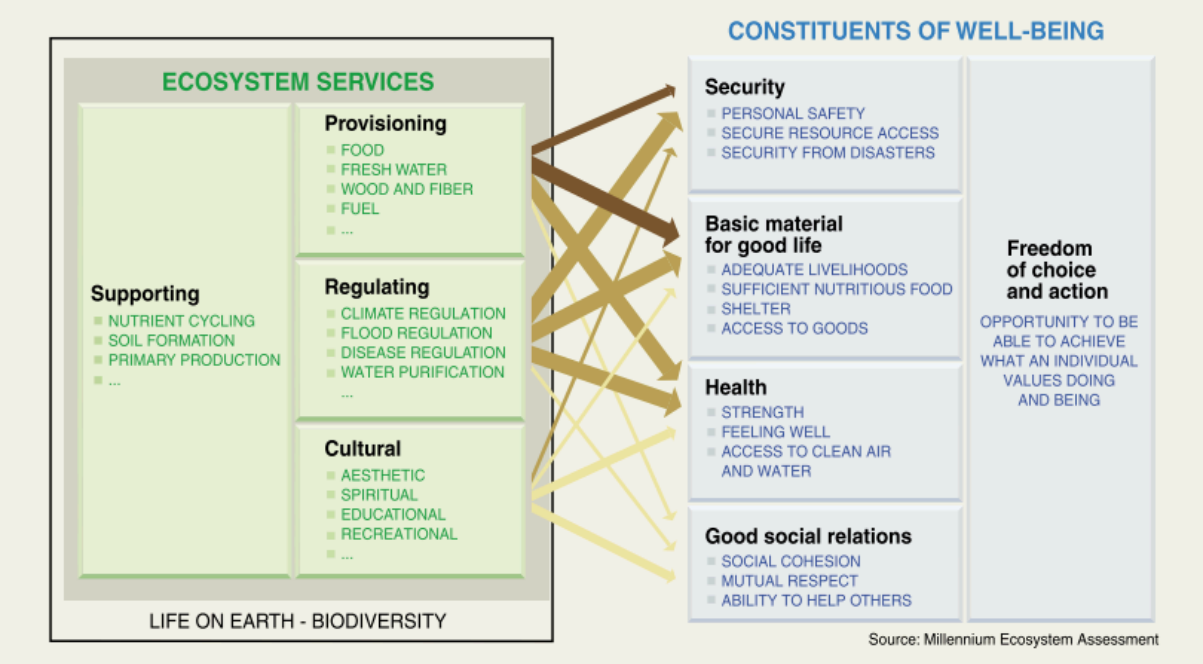


Figure 2–6 Ecosystem services and human well-being (Millennium Ecosystem Assessment, 2005)

These four services are defined as follows (Millennium Ecosystem Assessment, 2005). *Provisioning services* are the products obtained from ecosystems, including food, fuel, water, biochemical and genetic resources, etc. *Regulating services* are the benefits obtained from the regulation of ecosystem processes, including air quality regulation, climate regulation and erosion regulation, etc. *Cultural services* are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences, including cultural diversity, knowledge systems, educational values and inspiration, etc. *Supporting services* are those that are necessary for the production of all other ecosystem services. They differ from provisioning, regulating and cultural services in that their impacts on people are often indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people. These supporting services include soil formation, nutrient cycling and water cycling, etc. This service is more fundamental compared to the first three services.

Since the 2005 report, many researchers have investigated the definition and classification of

ecosystem services. Some argue that the definition of ecosystem services should be aligned with and consider the decision context, along with the characteristics of the ecosystems (Fisher, Turner, and Morling, 2009). Some argue that ecosystem services lack a consistent measurement, which has caused inconsistent methods and divergent definitions of ecosystem services, and therefore propose a systemic measurement framework (Boyd and Banzhaf, 2007).

However, some researchers still contend that ecosystem services are different from ecosystem functions in that services should always be considered as outcomes rather than processes (Forsyth, 2015). In that sense, the concept of ecosystem services is closer to ecosystem functioning rather than functions. Nevertheless, it has been widely accepted that ecosystem services should be defined as the benefits that humans obtain from ecosystems. Employing the ecosystem services concept is intended to support the development of policies and instruments that integrate social, economic and ecological perspectives (Seppelt *et al.*, 2011).

2.3.2 Business/Innovation ecosystems

The concept of the ecosystem in management literature was first introduced by Moore in 1993 from the ecological literature and he later defined it as "an economic community supported by a foundation of interacting organisations and individuals" (Moore 1996, p.26). Ever since Moore's seminal work, the literature on ecosystems has burgeoned and the topic has become popularised in academia and industry (Guo, Shi, and Tietze, 2017; Rong, Ren, and Shi, 2018). The current literature on ecosystems is divided into three streams, based on Adner (2017), as is shown in Table 2-2.

The first and earliest stream is Ecosystem-as-Affiliation. This stream, as can be seen from its name, focuses more on the main roles and actors that constitute a business ecosystem (Iansiti and Levien, 2004b, 2004a). Scholars in this foundational stream have explored the implications of this concept for firm operation strategies and innovation strategies (Moore 1993, 1996; Adner 2006). In this stage, scholars agree roughly that an ecosystem is a community of actors that interact with each other and such interactions bring about impacts to actors within the

ecosystem (Teece, 2007).

Table 2–2 Business/Innovation ecosystem research streams

Ecosystem-as-	Affiliation	Structure	Process
Representative definition	The community of organisations, institutions and individuals that impact the enterprise and the enterprise's customers and suppliers (Teece 2007)	Collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution (Adner 2006)	A community consisting of loosely connected and interdependent organisations that co-evolve with partners and their business environment (Shi and Rong, 2014)
Main argument	View of extended enterprise	Value co-creation arrangements, complex interdependencies	Evolutionary nature of ecosystems
Unit of analysis	Focal firms	Collaborative arrangements or focal firms	Focal firms or ecosystems
Method	Theoretical	Quantitative and qualitative empirical	Qualitative empirical
Empirical setting/sectors	Automotive industry; internet sector (start-ups); mobile devices; IT	Package software; IT; solar photovoltaic; PC gaming; semiconductor	Mobile phone; telecommunication; TV; microprocessor
Representative studies	Iansiti & Levien (2004a, b); Moore (1993, 1996); Teece (2007)	Adner (2006, 2012, 2017); Adner & Kapoor (2010, 2015); Kapoor & Lee (2013); Hannah & Eisenhardt (2018); Jacobides et al. (2018)	Garnsey and Li, 2012; Rong and Shi, 2014, Rong et al., 2015; Clarresse el al., (2014), Thomas et al. (2014), Thomas and Autio (2015, 2016); Liu and Rong (2015); Ansari, 2016; Autio et.al. (2018)

The second stream is Ecosystem-as-Structure. Adner claims the vital importance of complementors in value co-creation with focal firms (Adner 2006, 2012), in addition to the traditional supply chain scenario. Later, Adner and Kapoor (2010) argued that the bundles of innovation are crucial for focal firms to successfully deliver products to consumers by integrating the complementors' innovations with their own. Further empirical studies have revealed how complementary activities in the innovation ecosystem affect firms' technological investments (Kapoor and Lee, 2013), and how technology substitution is contingent on ecosystem challenges for new technologies and ecosystem extension for existing technologies (Adner and Kapoor, 2016). Complex interdependencies are also heterogeneous across the

ecosystem and should be managed differently (Shi *et al.*, 2016) in order to cope with the coopetition dynamics (Hannah and Eisenhardt, 2018), as the technological interdependencies brought by modularity in both consumption and production sides determine the boundary of the ecosystem (Jacobides, Cennamo, and Gawer, 2018).

The third stream is Ecosystem-as-Process. Scholars have noted the temporal and dynamic nature of business ecosystems and therefore adopted an evolutionary perspective. Moore (1993) first introduced business ecosystem life cycles. Rong et.al. further explored the co-evolution process of business ecosystems and called for a more dynamic ecosystem conceptual framework (Liu and Rong, 2015; Rong *et al.*, 2015; Shi *et al.*, 2016; Shi and Liang, 2015). Further work in this stream uncovered how new entrants leverage the ecosystem dynamics to introduce their disruptive innovations and how the process unfolds (Ansari, Raghu, and Kumaraswamy, 2016). Meanwhile, the assumed *ex ante* value propositions with which focal firms build their ecosystems in the Ecosystem-as-Structure stream do not hold when technology uncertainties are high, meaning that firms have to deal with *ex post* propositions as the ecosystem evolves (Dattée, Alexy, and Autio, 2018).

2.3.3 Agglomeration economics

Successful factors of agglomeration

Agglomeration economics dates back to the 1920s, when Cambridge economist Alfred Marshall observed that firms tend to concentrate in particular areas and proposed three factors that led to this phenomenon (Marshall 1920):

Local skilled labour pool. The first successful factor Marshall proposed is that industrial localisations can provide a pooled market for workers with specific skills. The local labour pool can, on the one hand, offer firms an abundant supply of workers when worker demand increases rapidly, and, on the other hand, provide firms with convenient access to workers with specialised skills, which reduces the training cost if otherwise (McCann, 2013).

Non-tradable specialised inputs. The second factor is that industrial localisations could support the production of non-tradable specialised skills. There are two types of non-tradable inputs. One is the specialised low-cost services or offerings to companies of the same industry within the area because the concentration of companies of the same industry has spread the costs of providing such services or offerings, such as testing firms in automobile clusters. The other is local infrastructure, which is provided to all firms in the same area (McCann, 2013).

Information spillovers. Another factor is the information spillover, from which companies in the same area gain competence compared to those outside the cluster. The proximity and concentration of firms mean that the sharing and interaction between them happen more frequently and easily compared to in firms with dispersed distribution. Such information advantage will enable firms to deal with rapid market changes.

Types of agglomeration

Hoover then investigated the different types of agglomeration, which are internal returns to scale, economies of localisation and economies of urbanisation.

Internal returns to scale. Hoover uncovered that sometimes agglomeration is not driven by external factors but is rather internal to firms in that achieving economies of scale will reduce cost significantly and therefore a huge investment in a particular region occurs, resulting in a large group of firms within the same industrial sector (Hoover, 1937).

Economies of localisation. Another type of agglomeration is that suppliers of a particular sector concentrate within the same area as their customers (Hoover, 1948). For example, in automobile cities such as Detroit, suppliers of automobiles together with automobile manufacturers form a cluster.

Economies of urbanisation. Further, the agglomeration extends to firms from totally different sectors, and attracts various service industries and residents, which then leads to the urbanisation of a region. This type of agglomerations has been classified as economies of

urbanisation (Jacobs, 1960).

Drivers of agglomeration

Following Marshall's research into agglomeration, many researchers have proposed the potential drivers of agglomeration. Myrdal's circular causation theory (Myrdal, 1957) and Arthur's positive feedback theory (Arthur, 1989) have suggested that manufacturers' production will tend to concentrate where there is a large market, but the market will be large where manufacturers' production is concentrated, which partially explains why a cluster is formed. Further, Pred and Meyer examined the role of circular processes in the emergence of the US manufacturing belt during the 1850s to 1900s (Meyer, 1983; Pred, 1966), but they did not explicitly address the fundamental question of why agglomeration happened (Krugman, 1990).

In 1990, Paul Krugman finally proposed the reasons why agglomeration happened. He reveals how manufacturing generally ends up concentrating in one or a few regions (Krugman 1990, 1991a, b): economies of scale, low transportation costs and the share of manufacturing in the national income.

2.3.4 Cluster

The concept of clusters is used in many areas. The business management community and economics community seem to have disputes regarding the use of clusters. In the management community, Porter's concept of clusters is derived from his research into competitiveness (Porter, 1985), which laid down the foundation of strategic management. He then argued that the cluster is crucial for organisations and firms to compete and thus innovate, which gives the cluster higher competitiveness (Porter, 1990). Porter's arguments are derived from his case studies in several different clusters and countries. In the economics community, the key reason for the divergence lies in the fact that the phenomenon of agglomeration is derived from the assumption of a firm's behaviours, i.e. the location theory, which is very different from Porter, as he would not make any assumptions on the nature of the firm or the market conditions. As

Porter's approach is widely accepted in the management community, this section follows his stream of research.

Porter defines clusters as geographical concentrations of interconnected companies and institutions in a particular field (Porter 1991, 1996). He argues that clusters are critical to competition, which is reflected in productivity, innovation and new business formation. Subsequently, many researchers have complemented the research on clusters. For example, Tallman et.al. (2004) investigated the role of informal knowledge sharing within clusters and proposed that the informal knowledge sharing is indeed crucial for firms within the clusters to gain competitive advantages. There is also research on different types of clusters, in terms of who drives the cluster and what industries the cluster is specialised on (He and Fallah, 2011).

However, the existing research is more from a static view rather than a dynamic view. Regional economics and cluster research among management communities has focused more on the drivers and factors leading to the agglomeration phenomenon but failed to investigate the subsequent evolution of clusters. Some researchers have realised this and tried to link clusters with industry life cycle (Audretsch and Feldman, 1996; Menzel and Fornahl, 2009). There is also some initial research regarding conceptualisation of cluster evolution (Boschma and Fornahl, 2011; Martin and Sunley, 2011). But this stream of research is still at its early stage. Also, research regarding cluster performance is very scarce. Although Porter acknowledges that the health or performance is vital to the development of clusters, there is surprisingly little research evaluating cluster health or performance.

2.3.5 Regional innovation systems

The concept of regional innovation system was first proposed by Cooke, where it was used to examine the role of regulation associated with innovation (Cooke, 1992). He identified three models of technology transfer: the grassroots approach, in which the need for technology transfer originates from the local level, the network approach, which highlights the necessity for policy guidance during the transfer process, and the dirigiste approach, which is the

opposite of the grassroots approach (Cooke, 1992). He then further clarifies the concept of regional innovation system by highlighting the definition of region and differentiating the use of the term 'innovation' from other similar concepts. He argues that strengthening regional-level capacities could help promote both systemic learning and interactive innovation (Cooke, Uranga, and Etxebarria, 1997).

Later, Cooke compares regional innovation system with clusters and concludes that the public innovation support systems along with institutional and organisational support from the private sector are crucial for filling the innovation gaps (Cooke, 2001). Other researchers joined in the dialogue and began to investigate regional innovation systems' characteristics and dynamics. For example, some researchers have explored the Nordic regional innovation systems that help local firms gain place-specific resources (Asheim and Isaksen, 2002) and how the different types of regional innovation systems vary according to different knowledge bases (Asheim and Coenen, 2005).

Nevertheless, regional innovation systems are more concerned with technology transfers between research institutes (Chen and Kenney, 2007) and industries, and how government policies could assist in this process (Tödtling and Trippl, 2005). The triple interaction among universities, governments and firms is the distinctive unit of analysis, differentiating this concept from other related concepts such as clusters.

2.3.6 Summary: how is the entrepreneurial ecosystem different?

Despite drawing from the above antecedents and interdisciplinary linkages, the entrepreneurial ecosystem serves as a key concept to tackle regional entrepreneurship and development issues in modern societies. The differences between entrepreneurial ecosystems and other related concepts are highlighted in Table 2-3.

Entrepreneurial ecosystems are different from regional innovation systems or clusters. First, unlike regional innovation systems which are often organised and led by government bodies or universities, entrepreneurial ecosystems can emerge spontaneously, with a bottom-up approach,

as evidenced from Thompson *et al.* (2018). This approach also differs from clusters, where often large corporations and established companies lead the emergence and evolution, whereas the emergence and leadership of an entrepreneurial ecosystem can be attributed to SMEs and entrepreneurs. Second, as entrepreneurial ecosystems are less likely to be hierarchical and more likely to be decentralised, unlike regional innovation systems and clusters in particular, they tend to be more autonomous in terms of governance mechanisms and more divergent in terms of strategic orientations among actors. Third, different to clusters, which often represent one single industry, entrepreneurial ecosystems transcend the notion of industry (Moore, 1996; Spigel and Harrison, 2018) and focus more on facilitating new venture creation from any generative technologies.

Table 2–3 Comparison of entrepreneurial ecosystems with other related concepts

Themes	(N)/RIS	Clusters	B/IE	EE
System leadership	Usually led/organised by government bodies; a top-down approach	Led by MNCs or anchor organisations, or government-led	Focal firms	Varied (can emerge spontaneously or proactively by government)
Governance mechanisms	Authority/Power	Market	Market	Autonomy
Actors	Triple helix: industry, universities/research institutes and government bodies	Value chain players (SMEs or MNCs), complementary resources, governments and universities	Focal firms, suppliers, complementors: complex interdependencies	Entrepreneurs, local suppliers and complementary resources, universities, governments, intermediary organisations.
Industry focus	Generally high-tech; can be multiple industries	Usually one single industry	Can be any industries depending on the focal firms' product offerings	General high-tech; can be multiple industries
Strategic orientation	Regional development	Regional development and profit making for cluster leaders	Value creation and profit making for all ecosystem actors	Absence of common visions among actors. Although can enhance regional entrepreneurship and development

Entrepreneurial ecosystems are also different from business/innovation ecosystems. Though an entrepreneurial ecosystem is also an ecosystem, it is in two ways different from a business or innovation ecosystem. One is, obviously, being entrepreneurial. An entrepreneurial ecosystem would mainly focus on new venture creation and start-ups' interactions with ecosystem actors, while an innovation ecosystem is more concerned with value co-creation by different players due to complex interdependencies, regardless of the heterogeneous nature of the participating organisations. The other is that entrepreneurial ecosystems are typically regional-based, whilst business/innovation ecosystems do not take into account the geographical dimension. Such an ecosystem is normally a firm-based or industry-wide ecosystem, such as Apple's ecosystem, or a smartphone ecosystem. An entrepreneurial ecosystem, however, is usually geographically bounded, such as Silicon Valley EE. The reason is twofold. On the one hand, the concept of entrepreneurial ecosystem emerged with a strong policy flavour, such as seen in Isenberg (2011), who has conceptualised the structures and domains of an entrepreneurial ecosystem with implications for economic policy. On the other hand, the emergence of EE is to some extent inspired by some successful entrepreneurial regions (Cohen, 2006; Mack and Mayer, 2015; Spigel, 2017). In order to be clear and consistent in this dissertation, based on previous literature, an entrepreneurial ecosystem is defined as: *a community of interconnected, interdependent and co-evolving actors that are involved in the new venture creation processes within a region.*

2.4 On 'health'

'Health' as a concept has emerged in several different disciplines and domains. In order to build a solid theoretical foundation for the conceptualisation of entrepreneurial ecosystem health, this section will discuss different usages and definitions regarding the concept of 'health'.

2.4.1 Organism and human health

Originally, 'health' as a term was used specifically for organisms and humans. For general organisms, it is defined as the level of functional or metabolic efficiency (Huber *et al.*, 2011).

But, in relation to human health, debates have been carrying on for hundreds of years. There are currently five main streams of health definitions, which will be discussed below.

Medical definition. The definition of health in medical practice and research is the absence of disease or disability (Larson, 1999). This definition goes back to as early as five hundred years ago when Descartes began to view the human body in the manner of a machine model, which is structured, and therefore gave birth to the idea of illness occurring in individuals. Although there have been debates about the definition and scope of disease such as the contention of physical and mental illness, social and biological disease, this view has helped medical research advance a great deal since the birth of modern science (Larson, 1999).

WHO definition. The World Health Organisation has proposed a more holistic definition: health is "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (WHO 1946, p.3). However, this definition has been questioned by many researchers. Firstly, the absoluteness of the word "complete" is widely criticised. Secondly, the nature of disease has changed rapidly and greatly since 1946, such as chronic diseases, and the old definition seems unfit and outdated. Thirdly, the operationalisation of the WHO health definition is very poor (Huber *et al.*, 2011) and some even consider it as idealistic and immeasurable (Larson, 1999).

Wellness model. The wellness model seeks to combine the impact of mental health with physical health and aims at a higher level of wellness (Larson, 1999). It defines health as "Health promotion and progress toward higher functioning, energy, comfort, and integration of mind, body, and spirit." (Larson 1999, p.25). However, some have pointed out its problems such as: the perception of wellness is difficult to measure as it varies hugely across different age and gender groups. Despite these criticisms, this definition indeed brought mental status under the umbrella of health, which is a great advance for medical research and practice.

Environmental consideration. Similar to the view of the wellness model that includes humans' internal status in the concept of health, this definition incorporates the impact of the surrounding environment on human health. Breslow argues that health is not merely biological

elements or social role performance but is a dynamic equilibrium with the environment and the capacity to live physically, mentally and socially (Breslow, 1989; Larson, 1999).

View of adaptation. As the definition of health continuously evolves, the view of adaptation has become more convincing. Since health includes environmental consideration, researchers have gradually turned to the view of adaptation, where they argue that health is about the ability to adapt, rather than about perfection or being "complete" or the "absence of disease" (The Lancet, 2009). The definition of this view has been summarised as "the ability to adapt and to self manage in the face of social, physical, and emotional challenges." (Huber et al. 2011, p.2), which combines all the dimensions of the previous definitions.

2.4.2 Biological ecosystem health

The concept of natural ecosystem health stems from ecosystem stresses, which represent the responses of ecosystems to external stimuli (Odum, 1985). Ecosystem health was first defined by Rapport et al. in 1985. Relating to the concept of human health, Rapport argues that ecosystem health can be diagnosed and thus defined through multiple indicators and dimensions, which are changes in nutrient cycling, changes in primary productivity, changes in species diversity, retrogression (an apparent reversion to an earlier stage of the successional process) and changes in size distribution of species (Rapport, Regier, and Hutchinson, 1985). Further work has been conducted by other researchers to differentiate human or animal health from ecological health, reflecting a significant difference in diagnosing criteria and indicators (Schaeffer, Herricks, and Kerster, 1988). Rapport further developed the dimensions of evaluating ecosystem health, stating that ecosystem health, as a concept to assess the condition of the environment, could be evaluated in six dimensions: primary productivity, nutrients, instability, disease prevalence, size spectrum and contaminants (Rapport, 1989). In the 1990s, researchers focused on developing indicators for evaluating ecosystem health and conducting quantitative tests using their frameworks (Cairns, McCormick, and Niederlehner, 1993; Mageau, Costanza, and Ulanowicz, 1995; Rapport, 1992). At this point, there was no consensus on frameworks for evaluating ecosystem health.

In 1999, Rapport proposed his final definition and dimensions of ecosystem health, which is widely accepted as the most accurate and rigorous framework. He argues that ecosystem health can be defined and also evaluated through three dimensions (Rapport, Costanza, and McMichael, 1999):

- Vigour: represents the activity, metabolism or primary productivity of an ecosystem;
- Organisation: represents diversity and interactions between species in the ecosystem;
- Resilience: the capacity of the ecosystem to deal with disruptions.

2.4.3 Firm (financial) health

There is no formal definition of firm health. When researchers talk about a firm's health, they actually mean the firm's financial performance or health. There are a number of models depicting the firm's financial performance.

For example, many investment banks use the firm bankruptcy model to estimate a firm's financial status by calculating its bankruptcy probability. The Z-score model was the first of its kind (Altman, 1968) and the function is as follows:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$$

Where $X_1 = Working\ capital/Total\ assets$

$X_2 = Retained\ earnings/Total\ assets$

$X_3 = Earnings\ before\ interest\ and\ taxes/Total\ assets$

$X_4 = Market\ value\ equity/Book\ value\ of\ total\ debt$

$X_5 = Sales/Total\ assets$

$Z = Overall\ Index$

Building on the Z-score model, a ZETA model was proposed in order to reflect the new changes to the financial statements and align the model with them (Altman, Haldeman, and Narayanan, 1977). This model, compared to the Z-score model, has more indicators such as capitalisation measured by common equity to total capital and stability earnings measured by a normalised measure of the standard error around a 10-year trend in return on assets, thus adding up to a 7-variable model (Altman *et al.*, 1977).

However, Altman's work was criticised for its assumptions of linear separability, multivariate normality, and independence of the predictive variables (Lacher *et al.*, 1995). Researchers then proposed a neutral network approach instead of the original MDA approach to overcome these problems. By adding a hidden unit which considers the impacts of bias, this model could produce more accurate and independent outputs compared to the traditional MDA approach (Lacher *et al.*, 1995). Further studies have empirically confirmed that neutral networks are robust to sampling variations in overall classification performance (Yang, Platt, and Platt, 1999; Zhang *et al.*, 1999) in different contexts (Mokhatab Rafiei, Manzari, and Bostanian, 2011).

2.4.4 Business ecosystem health

Business Ecosystem Health was first proposed by Iansiti and Levien (2004a) as three dimensions – Robustness, Productivity and Niche Creation – largely borrowed from biological literature discussing ecosystem health. They claim that the three dimensions are "measures of the extent to which an ecosystem as a whole is durably growing opportunities for its members and for those who depend on it". Dimensions and their definitions as well as the main indicators within each dimension are listed in Table 2-4. It should be noted that some of these indicators might not be applicable in certain industries, according to Iansiti and Levien.

Iansiti and Richards (2006) revised this framework to make it applicable to their analysis of the health of the IT sector. In this framework, they replaced 'Niche Creation' as 'Innovation' and specified some indicators within each dimension, where labour productivity, financial betas, market indices and the return on venture investment, etc., are added to the original

measures. This framework has provided some preliminary understanding and assessment for IT ecosystem health. The frameworks Iansiti, Levien and Richards proposed have indeed provided a solid foundation for further research and it turns out that subsequent literature discussing business ecosystem health is mostly based on their work.

Table 2–4 Iansiti & Levien's framework

Dimension	Definition	Main Indicators
Robustness	Capability of a business ecosystem when "facing and surviving perturbations and disruptions" (Iansiti and Levien, 2004a, p33)	Survival rates; Persistence of ecosystem structure; Predictability; Limited obsolescence; Continuity of use experience and use cases
Productivity	A network's ability to consistently transform technology and other raw materials of innovation into lower costs and new products	Total factor productivity; Productivity improvement over time; Delivery of innovations
Niche Creation	The capacity to increase meaningful diversity over time through the creation of new valuable functions	Variety; Value creation

Hartigh, Tol and Visscher (2006) constructed a model that "enables managers to monitor the financial and network health of their business ecosystem" (Hartigh et al. 2006, p.1). Meanwhile, they also discussed the managerial insights drawn from the application of their instrument regarding three aspects – benchmarking and improving business ecosystem performance, partner engagement process and business ecosystem governance. By selecting and specifying every indicator using different measures from different fields such as network analysis and financial performance, the authors have established a model that they claim to be useable in a management practice on multiple levels. The dimensions in this model are quite different from Iansiti and Levien's, which are included together with the indicators in each dimension in Table 2-5.

Table 2–5 Hartigh, Tol and Visscher's model

Dimension	Definition	Indicators
Partner Health	A long-term financially-based representation of a partner's strength of management and of its competencies to exploit opportunities that arise within the ecosystem	-EBIT/total assets -Total revenue/total assets -Liquidity -Solvency & solvency t-1 -Retained earnings/total assets -Total asset growth -Working capital/total assets
Network Health	A representation of how well a partner is embedded in the ecosystem as well as the impact the partner has in its local network	-Number of partnerships -Visibility in the market -Covariance of partner variety with the market

2.4.5 Regional resilience

A key notion in regional studies that scholars often draw upon when they think of a region's sustained economic development and performance faced with external shock (Boschma, 2015) is *regional resilience*, as seen in Figure 2-7. Although there seems to be different approaches when it comes to how scholars perceive and measure risk and resilience in a region (Christopherson, Michie, and Tyler, 2010), a key common understanding of regional resilience adopts an evolutionary view, which argues that regional resilience is a manifestation of collective actions and behaviours of all relevant stakeholders within the region over time. This means that regions are in constant transition and between these transitions are key moments to study when probing into regional resilience (Christopherson *et al.*, 2010).

A key tension in the discussion of regional resilience is how regions can develop new growth paths (Boschma, 2015), going beyond merely overcoming the shocks at hand. Some argue that, in order for a region to possess the ability to develop new growth paths, from an evolutionary perspective, it has to reach a balance in adaptation and adaptability (Simmie and Martin, 2010). Adaptation means a region's ability to identify multiple possible new growth paths, while adaptability means its ability to adapt to a certain direction of growth (Boschma, 2015). In this sense, a region with a fine balance of adaptation and adaptability is less likely to be vulnerable to external shocks and therefore can be regarded as a resilient region.

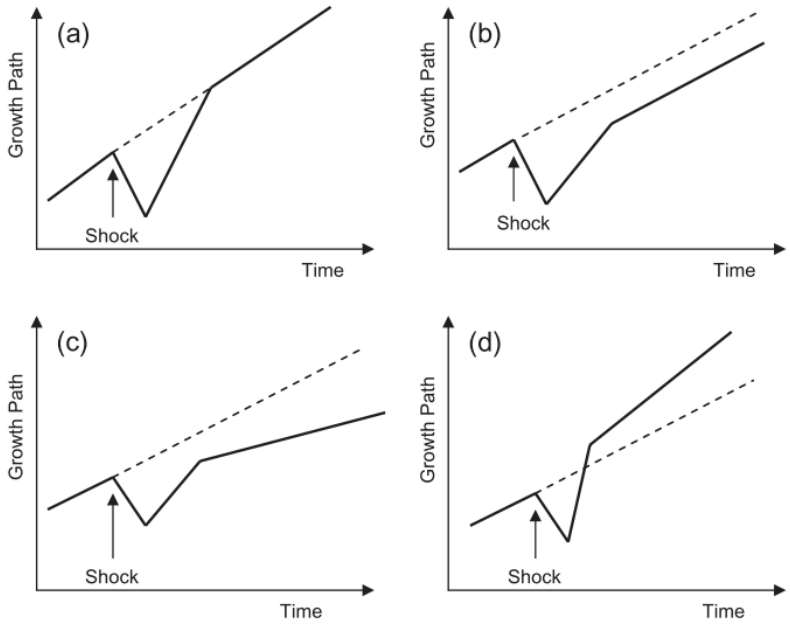


Figure 1. *Stylised Responses of a Regional Economy to a Major Shock.*
Notes: (a) Return of region to its pre-existing steady growth path following the shock; (b) and (c) region fails to resume former steady growth path after the shock, but settles on inferior path (d) region recovers from shock and assumes an improved growth path.

Figure 2–7 Different types of bouncing back from shocks (Simmie and Martin, 2010)

But what are the contributing factors of a resilient region? Scholars have proposed different factors to explain why some regions are more resilient than others. Christopherson *et al.* (2010) point out that a resilient region normally has the following salient features: (1) a strong system of innovation; (2) strength in factors that create a learning region; (3) A modern productive infrastructure; (4) A skilled, innovative and entrepreneurial workforce; (5) A supportive financial system providing patient capital; and (6) A diversified economic base, not over-reliant on a single industry. Martin and Sunley (2015), similarly, argue that industrial and business structure, labour market conditions, financial arrangements, governance arrangements, as well as agency and decision making are the key factors required to resist and recover from external shocks, as can be seen in Figure 2-8.

Although these factors describe the salient features of a resilient region in terms of economic development, particularly in terms of the individual and collective functionalities of different stakeholders of an innovative region, they do not necessarily shed light on the underlying mechanisms of how and why these factors contribute to regional resilience and in particular

for regional entrepreneurship.

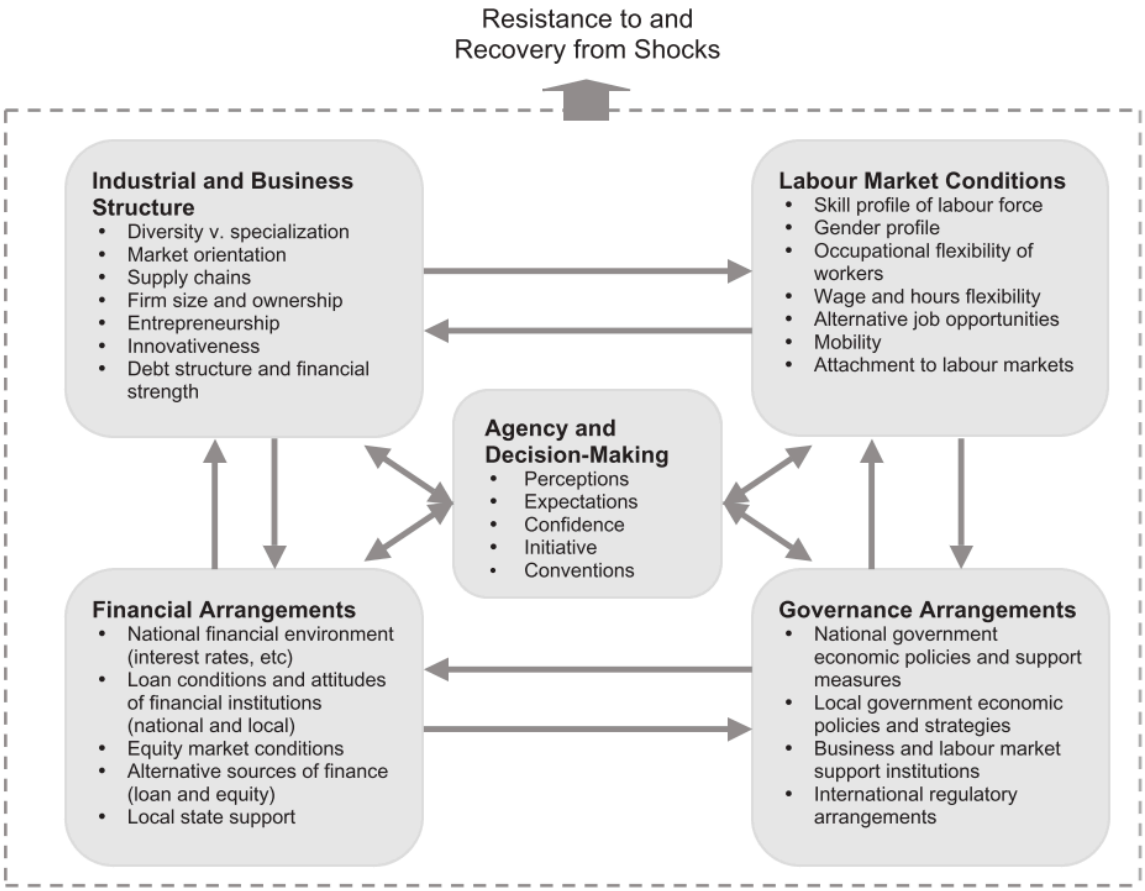


Figure 2–8 Determinants of regional resilience (Martin and Sunley, 2015)

2.4.6 Determinants of regional entrepreneurship

Scholars have long been interested to see what leads to regional disparities in terms of new venture creation (Armington and Acs, 2002). Muller (2016) has divided this stream of literature into four categories – how institutional structures, economic structures, social structures and spatial structures influence regional entrepreneurial activities.

For institutional structures, scholars focus on both formal and informal institutional structures. Formal institutional structures include government and policy support that foster the creation of a knowledge base (O'Gorman and Kautonen, 2004) and provide entrepreneurial support services (Zhou, 2011). Informal institutional structures mainly refer to entrepreneurial culture

such as risk-taking perceptions, social acceptance and legitimacy, and entrepreneurial environment (Beugelsdijk and Noorderhaven, 2004). Economic structures mainly include macroeconomic performance such as labour availability, financial capital, unemployment rate, etc. (Audretsch and Fritsch, 1994; Audretsch and Keilbach, 2004). Social structures address the impacts of social capital and formal and informal networks (Ma, 2002) over new venture creation activities (Audretsch and Keilbach, 2004). Finally, spatial structures are concerned with the availability of supporting and complementary resources in the region, such as local infrastructure (Benneworth, 2004), proximity to universities and research institutes (e.g. Cambridge, UK) (Garnsey and Heffernan, 2005), as well as role models and other regional entrepreneurial capital (Meccheri and Pelloni, 2006).

Extant literature on determinants of regional entrepreneurship has provided some useful directions to explore the health of an entrepreneurial ecosystems. However, the literature is rather scattered in this stream and, most importantly, fails to examine the reciprocity between these structures and regional entrepreneurship. Surely, the presence and availability of all kinds of regional resources and structures will have impacts on regional entrepreneurship. However, it remains unclear whether there would be impacts from regional entrepreneurship, in return, to regional structures.

2.5 Research gaps and research question

Four research gaps have been identified in terms of entrepreneurial ecosystems and regional entrepreneurship literature.

Firstly, the performance and competitiveness of entrepreneurial ecosystems have not been sufficiently addressed in existing entrepreneurial ecosystem literature, although it has been frequently acknowledged that the health of the whole ecosystem is crucial to all players involved (Iansiti and Levien, 2004a; Iansiti and Richards, 2006). Despite the fact that there is an increasing number of studies on entrepreneurial ecosystems, especially on their key components and building blocks (Isenberg, 2011; Spigel, 2017), relatively less is known about

what constitutes the health of an entrepreneurial ecosystem and what are the key dimensions for unpacking entrepreneurial ecosystem health. Nevertheless, the importance of ecosystem health for the fate of all members has been noted in various literature (Iansiti and Levien, 2004a; Iansiti and Richards, 2006; Porter, 2000).

Secondly, although extant entrepreneurial ecosystem literature has elaborated clearly on what constitutes an entrepreneurial ecosystem, i.e., the structures and domains of an entrepreneurial ecosystem (Autio *et al.*, 2018; Cohen, 2006; Nambisan and Baron, 2013; Qian *et al.*, 2013; Spigel, 2017), frameworks taking a dynamic and evolutionary perspective are still insufficient (Alvedalen and Boschma, 2017). Meanwhile, scholars widely acknowledge that entrepreneurial ecosystems are in their nature dynamic and temporal (Auerswald and Dani, 2017; Thompson *et al.*, 2018). Although a few scholars have made some early attempts on ecosystem lifecycle (Mack and Mayer, 2015), ecosystem process (Spigel and Harrison, 2018), and ecosystem structural models (Autio *et al.*, 2018), more insights on how the entrepreneurial ecosystem evolves, and especially how ecosystems co-evolve with actors as well as the resultant implications can be offered via further empirical research (Acs *et al.*, 2017). The dynamic perspective of entrepreneurial ecosystems may also be useful when considering the health of the entrepreneurial ecosystem. Prior research on related concepts such as determinants of regional entrepreneurship, regional resilience and business ecosystem health generate insightful dimensions for understanding the competitiveness of entrepreneurial ecosystems, but largely remain static, providing snapshots of performances rather than an evolutionary picture.

Thirdly, the reciprocity of entrepreneurial ecosystems and the actors embedded within them remains unclear. Prior entrepreneurship theorists, in particular, are more concerned with how entrepreneurial firms can access resources from innovation networks within the industrial clusters (Lechner and Dowling, 2003), the effects of knowledge spillovers on strategic entrepreneurships (Agarwal, Audretsch, and Sarkar, 2010) and new venture formations (Agarwal, Audretsch, and Sarkar, 2007; Grossman and Helpman, 1996). Although there has been abundant literature explaining how regional resources enable regional entrepreneurship

and how regional entrepreneurship promotes regional development, relatively less is known about whether regional entrepreneurship, in turn, benefits regional contexts, and, if so, what the underlying mechanisms are (Müller, 2016), as can be seen in Figure 2-9.

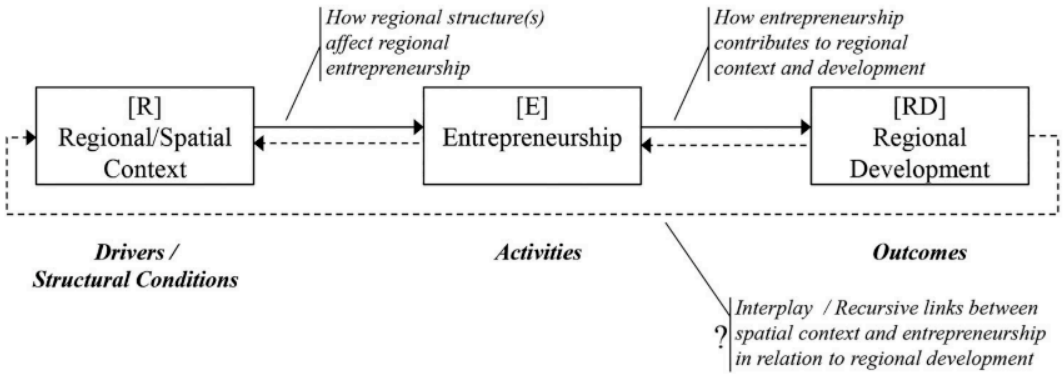


Figure 2–9 Predominant research directions (Müller, 2016)

Finally, extant research has shed less light on how individual entrepreneurs are connected to entrepreneurial ecosystems. Just like the discussions about who regional development is for (Pike *et al.*, 2007), scholars ought to think about whom the entrepreneurial ecosystem serves. Although early entrepreneurial ecosystem literature was born with a policy flavour (Isenberg, 2011; Mason and Brown, 2014), it is equally important to understand how individual entrepreneurs access resources from entrepreneurial ecosystems and, more broadly, how they benefit from the ecosystems, as doing so will also contribute to understanding how they benefit the ecosystems in turn. Indeed, some early work has drawn attention, for example, to how entrepreneurial ecosystems emerge with the efforts of individual entrepreneurs and intermediary actors (Thompson *et al.*, 2018). This implies that individual entrepreneurial activities may contribute to the overall ecosystem health, yet extant research does not fully understand the underlying mechanisms. Examining the health of entrepreneurial ecosystems from an entrepreneurial process perspective may offer opportunities to shed light on the identified gaps in the current literature.

Based on the literature review and research gap analysis, the overarching research question of this dissertation is:

How do we unpack the concept of entrepreneurial ecosystem health from an entrepreneurial process perspective?

The overarching research question is further divided into three research sub-questions that will together be answered in the following chapters.

Research sub-question 1: What are the dimensions for entrepreneurial ecosystem health?

Research sub-question 2: How do individual entrepreneurial activities contribute to collective entrepreneurial ecosystem health?

Research sub-question 3: How does a healthy entrepreneurial ecosystem facilitate new venture creation?

2.6 Summary

By reviewing three streams of literature – geographies of entrepreneurship, interdisciplinary linkages of entrepreneurial ecosystems, as well as various usage of 'health' and related concepts, this chapter identifies four research gaps:

- Key factors for the performance or competitiveness of entrepreneurial ecosystems are not well understood;
- Frameworks taking a dynamic and evolutionary perspective are still insufficient;
- The reciprocity of entrepreneurial ecosystems and the actors embedded within them remains unclear
- Less light has been shed on how individual entrepreneurs are connected to entrepreneurial ecosystems

This dissertation therefore aims to answer the overarching research question: ***How do we unpack the concept of entrepreneurial ecosystem health from an entrepreneurial process perspective?***

3. Research Methodology

3.1 Introduction

In this chapter, the methodology used for the enquiry including research design, data collection and data analysis will be introduced based on the research question raised in Chapter 2.

3.2 Research Design

3.2.1 Epistemological positions

How social science research should be conducted remains a debatable topic among researchers believing in different epistemologies. Positivism and interpretivism or social constructivism have become the two major positions (Johnson and Duberley, 2000).

Positivists insist that social science should follow the natural science model and therefore make law-like generalisations. Meanwhile, they believe qualitative research, such as case study, is the precursor for conducting quantitative research such as survey (Johnson and Duberley, 2000). Just like natural science experiments, positivists would argue that, in social science, researchers should also act like outsiders and maintain 'objectivity'. The detachment of researchers from data is a strong sign of positivism when a natural science paradigm is followed (Taylor and Bogdan, 1985).

Strong interpretivists, however, completely disagree with the positivists' stance, as they would reject any attempts to follow the natural science model, and argue that conceptual, instead of law-like, generalisations should be made through an inductive and interpretive approach (van Maanen, 2000). For social constructivism, researchers insist that data does not speak for itself and therefore all analysis is interpretive and, to some extent, subjective (Guba and Lincoln, 1994). The idea is that social science researchers cannot and should not be totally detached

from their research settings, but instead engage themselves in the research, which is very different from a natural science research paradigm.

However, there are signs that researchers are taking a more dogmatic approach to social science research. They believe positivism and social constructivism are both practical in their own rights and can be reconciled in certain scenarios. For example, some argue that qualitative research can deductively build theories based on previous literature and provide a logical framework that can potentially be utilised by other researchers to explain different phenomena in other contexts (Bettis and Gambardella, 2015; Eisenhardt, 1989). Meanwhile, qualitative methods can also inductively explore more open-ended questions concerning new phenomena in an attempt to provide general insights (Bansal and Corley, 2012). The diversity of epistemologies and research methods could bring readers closer to what is being studied (Bansal and Corley, 2011).

This research is regarded as weak social constructivism. The first part (Chapter 5) of the analysis follows an inductive approach to gain insights into entrepreneurial ecosystem health and its dimensions. The second part (Chapter 6) of the analysis also combines Eisenhardt's (1989) multiple case logic to identify patterns by comparing the entrepreneurial firms' resource acquisition behaviours, which helps develop propositions pertinent to the resource dynamisms of firm and ecosystem levels. Chapter 7 integrates findings in chapters 5 and 6 to offer a process model of how a healthy entrepreneurial ecosystem facilitates new venture creation over time.

3.2.2 Selection of research method

In social science research, there are several research strategies that are most frequently used, which are case study, experiment, survey, archival analysis and history. Each of these strategies has its own advantages and disadvantages, following different logic and rationales (Yin, 2009). The selection criteria are not based on the traditional hierarchical view that case study is most suitable for the preliminary research stage, survey is for the descriptive phase and experiment is for explanatory research. On the contrary, the criteria have nothing to do with the research

phases, but the three conditions listed in Table 3-1 (Yin, 2009):

Table 3–1 Relevant situations for different research strategies (Yin, 1989)

Strategy	Form of research question	Requires control over behavioural events?	Focuses on contemporary events?
Experiment	How & Why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival analysis (e.g. economic study)	Who, what, where, how many, how much	No	Yes/No
History	How, why	No	No
Case study	How, why	No	Yes

Specifically, for this research, the form of question is a 'how' type of question, as is shown in Chapter 3. Also, it does not require any control over behavioural events, since case study involves direct observation of events and interviews with people who are involved in these events that are being studied in the research (Yin, 1989). Finally, this research is focused on contemporary events. Therefore, the methodology selected in this research will be case study, as is demonstrated in Table 3-2.

Table 3–2 Selection of methodology for this research

Methodology	Form of research question: **How**	Requires control over behavioural events? **No**	Focuses on contemporary events? **Yes**
Experiment	✓	×	✓
Survey	×	✓	✓
Archival analysis (e.g. economic study)	×	✓	✓;×
History	✓	✓	×
Case study	✓	✓	✓

As shown in the literature review, there have been limited studies on entrepreneurial ecosystems, and in particular in terms of the dimensions of EE health. This indicates the necessity of an explorative study on entrepreneurial ecosystem health to build new theories (Yin, 2009). Further, according to Eisenhardt (1989), multiple case studies can be chosen to build up new theories in a more robust way, as patterns are consolidated in cross-case settings

(Eisenhardt, 1989; Eisenhardt and Graebner, 2007). In this sense, the intention is to inductively build a framework for entrepreneurial ecosystem health, and elaborate this new concept with adequate qualitative rigour (Gioia, Corley, and Hamilton, 2012).

3.2.3 Unit of analysis

An embedded multiple-case design was employed for this dissertation (Yin, 2009). The reason for an embedded design is that the research sub-questions pay attention to two different levels of phenomenon – ecosystem level and individual entrepreneurial firm level. This is because two levels of unit of analysis serve to answer three different sub-questions. For sub-research question 1, the unit of analysis is the entrepreneurial ecosystem, as the question sets out to explore possible dimensions for the ecosystem. For sub-research question 2, however, the intention is to explore how the individual entrepreneurial process benefits from a healthy entrepreneurial ecosystem. Therefore, the unit of analysis in this research sub-question becomes the key entrepreneurial firms identified in different evolutionary stages of the entrepreneurial ecosystems. Sub-research question 3 is concerned with the interactions between the individual level and the ecosystem level.

The reason for a multiple-case design is to increase external validity of the findings, for which single case studies are vulnerable. This is because a multiple case design offers opportunities to yield direct replications or contrasts, which therefore increase the generalisability of the findings beyond the specific case settings (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Yin, 2009). A multiple embedded case design offers an opportunity to follow a replication logic (Eisenhardt, 1989) and at the same time approach two levels of enquiry (Yin, 2009).

3.2.4 Selection of entrepreneurial ecosystems

As the unit of analysis in this study is entrepreneurial ecosystem, a theoretical sampling approach was followed to select relatively successful entrepreneurial ecosystems (Eisenhardt, 1989). Shenzhen in China and Silicon Valley in the US were selected as the main case

ecosystems, as is illustrated in Table 3-3. The author does realise that a case study approach is inherently defective in representativeness and generalisability (Siggelkow, 2007). However, the selection of cases in this dissertation can, to some extent, improve the validity of this research. The reasons are: (1) these two entrepreneurial ecosystems are the most successful ones in China and the US respectively; (2) China and the US are the world's largest economies, whose total economic power puts them in the top two places in terms of GDP, with a combination of approximately 40% of the total GDP output globally. They also share over 70% of the Unicorns (start-up companies valued at over $1 billion) globally[4]; (3) the selection covers regions from both developed and emerging economies, considering the heterogeneity of entrepreneurial conditions in relation to different stages of economic development; (4) the two EEs have highly similar industry profiles, both specialising in the information and communications technology (ICT) industry, making them more comparable and thus increasing internal validity when conducting cross-case analysis (Yin, 2009).

Table 3–3 Demographics of Silicon Valley and Shenzhen

Key profiles	**Silicon Valley**	**Shenzhen**
Industry	Mainly ICT (Microcomputers, electronics, software, etc.)	Mainly ICT (consumer electronics, telecommunications, software, etc.)
Ecosystem engines	Market (leading companies such as Google, Apple, etc.)	Hybrid of market and government
Innovation paradigm	Bottom-up	Hybrid of top-down and bottom-up
Capital market	Accounted for one-third of US venture capital investment	Shenzhen and Hong Kong stock exchanges
Population (million)	3.1[3]	12.53[2]
GDP (billion $)	666.9[5]	332[6]
Area (km^2)	4801[7]	2050[2]

Only regions that are widely perceived as successful entrepreneurial regions were selected.

[4] https://www.cbinsights.com/research-unicorn-companies

[5] http://www.sacbee.com/site-services/databases/article141819809.html

[6] http://www.sztj.gov.cn/xxgk/zfxxgkml/tjsj/tjnj/201712/W020171219625244452877.pdf

[7] http://siliconvalleyindicators.org/snapshot/

Indeed, some may challenge the absence of failing regions in this research. However, to answer the research question of how to evaluate the health of an entrepreneurial ecosystem, one needs to examine the successful ones in order to aggregate the features that make them successful. If failed regions were to be studied, this research might only end up identifying the reasons for their failure, not success, and, without doubt, such reasons may vary a great deal considering the heterogeneity of the regions. More importantly, avoiding factors for failure does not necessarily guarantee success and may well prove to be unrealistic, as failing regions all have their distinctive reasons for failure. Hence, selecting failing regions does not answer the research question.

The city of Shenzhen has a clear boundary set out by the central government of China, as shown in Figure 3-1.

Figure 3–1 Map of Shenzhen (Google Maps, 2018)

The boundary of Silicon Valley is relatively vague compared to that of Shenzhen as it is not an

administrative area of the United States. Rather, it is a collection of a few counties and cities in the broad southern San Francisco Bay Area. For the purposes of this enquiry, Silicon Valley includes San Jose, Mountain View, Palo Alto, Redwood City, San Mateo and San Francisco in the West Bay Area, as well as Berkeley, Oakland, Union City and Fremont in the East Bay Area, as seen in Figure 3-2.

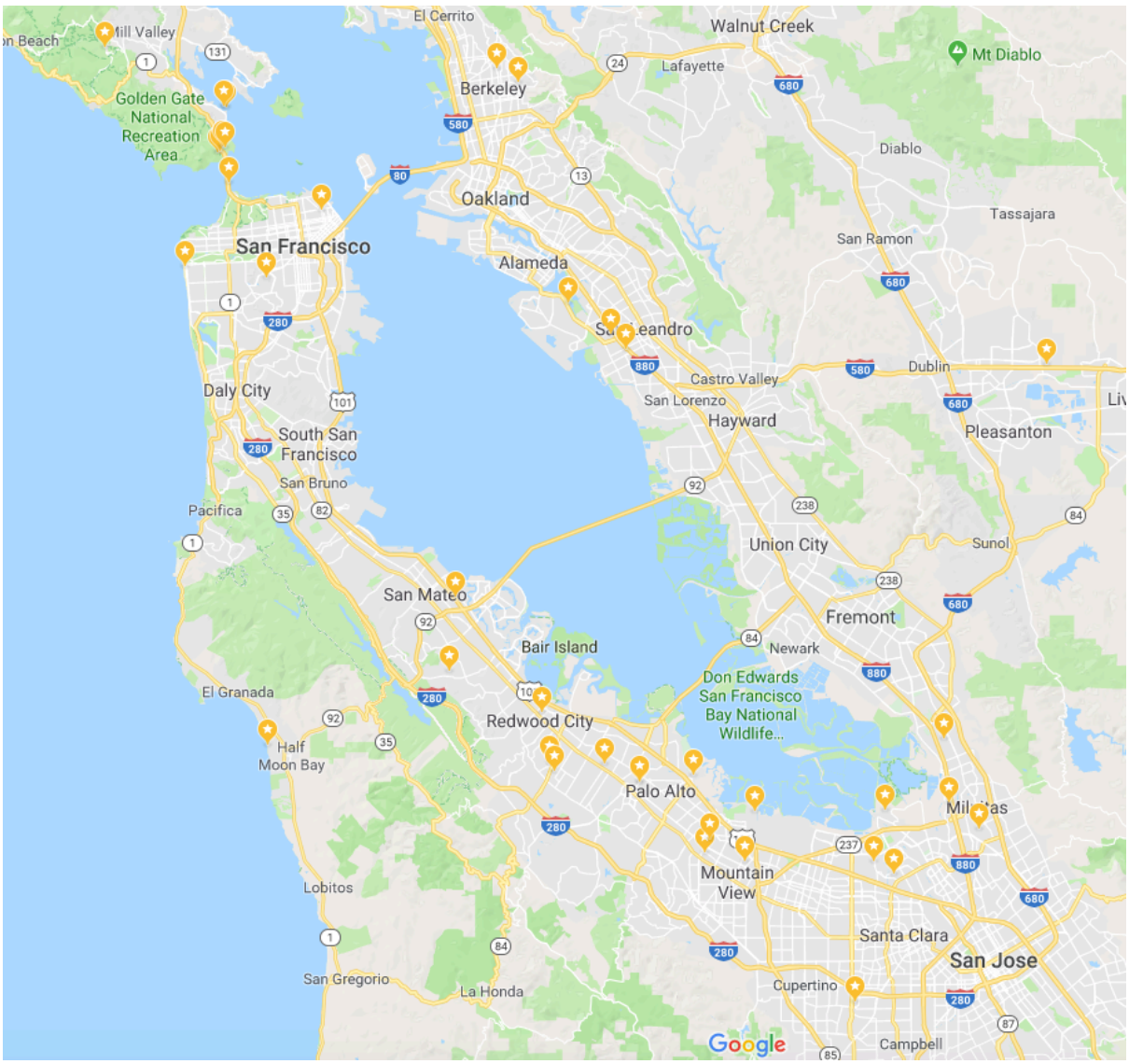


Figure 3–2 Map of Silicon Valley (Google Maps, 2018)

3.2.5 Selection of organisations and key entrepreneurial firms

As shown in section 3.1.3, two specific sets of interviewees and organisations are required to answer three different sub-research questions. Ecosystem-level informants were used to answer

sub-research question 1 and part of sub-research question 3, whilst entrepreneurial-process-level informants served to answer sub-research question 2 and part of sub-research question 3.

As for the interviewees and their organisations as ecosystem informants, the research sought different types of organisations operating in the entrepreneurial ecosystems, which could include individual entrepreneurs/start-ups, incubators and accelerators, government bodies such as city councils and regional governments, multinational corporations, and venture capitalists in different stages such as seed investors/angel investors (venture capitalists and individual investors) and mid-late stage investors (private equity), as have been outlined in previous literature (Spigel, 2017). When selecting start-ups to interview, the ICT industry was the primary focus, which is the main industry in the two case regions, and also the start-ups that are relatively successful in their respective market segment were selected. When selecting other ecosystem players, only those that are leading their respective sectors were chosen.

As for the selection of entrepreneurial-process informants, a theoretical sampling approach was employed. As is introduced in more detail later, interviews with ecosystem informants constitute phase one of the data collection. After the phase one data collection, the evolutions of both ecosystems were mapped out, based on both interview data and secondary data. Based on the evolutions of both ecosystems, the sampling of the entrepreneurial-process informants was then started. On the one hand, the author set out to select the entrepreneurial firms in different timeframes that have significantly influenced the development of the ecosystems, for example, organisations who facilitated the substitution of new technologies and/or created novel ways of new venture creation. They are representative firms in the salient industries in their corresponding development phase. On other hand, as Spigel and Harrison suggested (2018), there exists a continuum of willingness and abilities for entrepreneurs to access resources from the entrepreneurial ecosystems, and those who better access the ecosystem resources could have a superior performance. Therefore, in order to control this variable, the author aimed to select the companies that are undoubtedly perceived as successful entrepreneurial firms. Surely, these successful companies do not succeed only because they are proficient in terms of leveraging ecosystem resources, but they must have demonstrated

considerable willingness and abilities to utilise the ecosystem resources in an attempt to stand out among their competitors in the same ecosystems. In other words, selecting failed ventures in the ecosystem could risk attributing their failures to the ecosystem's resources not being readily available at the time of their new venture creation processes, rather than the endogenous factors, which does not serve to answer the research question. Regarding the selection from among a handful of successful ventures at the same stage, the criteria are as follows: (1) the venture must have substantial interactions with ecosystem resources; certainly, a firm can still succeed without much interaction with the ecosystem if the firm possess superior technologies or other resources and capabilities that could bring it competitive advantages. However, studying such a venture cannot yield sufficient insights for how the entrepreneurial ecosystem is benefiting the venture; (2) the firm needs to be impactful in its ecosystem's corresponding stages of development, normally through leading the representative industry in the ecosystem. Based on the above criteria, the selection of key entrepreneurial firms can be seen in Table 3-4.

Table 3–4 Selection of key entrepreneurial firms

	Ecosystem evolution	**Emerging**	**Growing**	**Mature**	**Renewal**
Silicon Valley	*Timeframe*	1956-1971	1972-1990	1991-2006	2007-
	Dominant sector	Semiconductor	Personal computer	Internet	Smart hardware
	Key entrepreneurial firm	Fairchild-Intel	Apple	Google	Tesla
Shenzhen	*Timeframe*	1989-1997	1998-2007	2008-	N/A
	Dominant sector	Contract manufacturing and Telecommunications	Shanzhai electronics	Smart hardware	N/A
	Key entrepreneurial firm	Huawei	Tencent	DJI	N/A

3.2.6 Selection of interviewees

As for the selection of interviewees, they were not limited to only senior managers in the organisations. Instead, for ecosystem informants in particular, those who have stayed in the case region for a relatively longer time or are well informed about the region as a whole were

selected. In this way, a more comprehensive view of how the interviewed organisations interact with ecosystem players and benefit from the ecosystems could be obtained. As is mentioned in the selection of ecosystem informants, the range was maximised into different types of players in the EE: governments, incubators, entrepreneurs, venture capitalists, etc., to cover different perspectives.

For entrepreneurial-process informants, the author aimed to select those who are familiar with the organisation's history, considering the fact that some of the organisations date back to decades ago when they were at the entrepreneurial stage. Where available, informants close to the top management were interviewed. If they were not available, employees with relatively good knowledge about the company's development were interviewed. These informants were familiar with the historical development of the key case companies because: (1) they might have stayed in the organisation for a long time and likely from the early stage of the venture; (2) they might belong to a particular division that requires them to understand more about the historical development of the organisation, for example, strategy analyst and public relation managers; (3) they might have had genuine interest in knowing about the entrepreneurial processes of their organisation prior to the interviews. What is equally important is that, during the interviews, the author asked for their recommendations for secondary sources such as books and monographs that most accurately describe the early stages of their companies.

3.3 Data collection

3.3.1 Data sources

The data sources in this research include primary and secondary data, in order to triangulate and improve external validity (Miles and Huberman, 1994; Yin, 2009). Before primary data collection, secondary data for background research was searched, including news articles, websites, government and industry reports as well as relevant journal papers and book chapters. In this phase, secondary data focuses on revealing the history, background and performances of these regions. Based on all this background research and literature, a primary data collection

protocol was further developed to guide the data collection from the semi-structured interviews. The protocol can also ensure the reliability of this research (Yin, 2009).

In the primary data collection phase, the author conducted site visits and collected data from all organisations, using semi-structured interviews complemented with observations and archival data. Suggestions from Eisenhardt (1989), Yin (2009) and Miles and Huberman (1994) were followed to design the interview process. The primary data collection took place in two phases, with the first phase from June 2016 to August 2016, and the second phase from March 2017 to June 2017, in both Shenzhen and Silicon Valley, as can be seen from Table 3-5, which provides a summary of all data collected and used. Cambridge University's formal rules on ethical considerations in social science research were applied during all the data collection phases.

Table 3–5 Data sources

Data Types	Collection Dates	Amount and Location
Primary Data		
Semi-structured Interview	74 Semi-structured Interviews lasting from 30 mins to 120 mins (07/07/2016 – 09/06/2018, see Table 3-6 for details)	122 pages of transcripts (English) and 136 pages of transcription (Chinese) from recordings
Naturalistic Observation	Visit to H&Q Asia Pacific Global Innovation Center (11/08/2016)	1 visit (Silicon Valley, US)
	Visit to British Telecom Venture Silicon Valley office (11/08/2016)	1 visit (Silicon Valley, US)
	Visit to Silicon Valley Venture Club (12/08/2016)	1 visit (Silicon Valley, US)
	Visit to Ufrate incubator (12/08/2016)	1 visit (Silicon Valley, US)
	Visit to Stanford University, Center for Sustainable Development and Global Competitiveness (12/08/2016)	1 visit (Silicon Valley, US)
	Visit to IBM Research – Almaden (15/08/2016)	1 visit (Silicon Valley, US)
	Visit to Tesla Motors (15/08/2016 to TM headquarters, 07/06/2017 to Fremont factory)	2 visits (Silicon Valley, US)
	Visit to Institute for Industrial Technology (15/08/2016)	1 visit (Silicon Valley, US)
	Visit to Smarking (15/08/2016)	1 visit (Silicon Valley, US)
	Visit to Apple (16/08/2016 to Apple headquarters, 09/06/2017 to a [non-disclosure] project site)	2 visits (Silicon Valley, US)
	Visit to Sigrity, subsidiary of Cadence (16/08/2016)	1 visit (Silicon Valley, US)
	Visit to Google (17/08/2016 and 01/06/2017 to Google headquarters, 09/06/2017 to Google X)	3 visits (Silicon Valley, US)
	Visit to Bluejay Mobile Health (17/08/2016)	1 visit (Silicon Valley, US)
	Visit to Huawei Silicon Valley office (18/08/2016)	1 visit (Silicon Valley, US)
	Visit to Upwork (18/08/2016)	1 visit (Silicon Valley, US)
	Visit to ZGC innovation centre (19/08/2016)	1 visit (Silicon Valley, US)
	Visit to Midas Touch (19/08/2016)	1 visit (Silicon Valley, US)
	Visit to SVInsight (30/05/2017)	1 visit (Silicon Valley, US)
	Visit to Intel Museum (01/06/2017)	1 visit (Silicon Valley, US)
	Visit to Facebook (01/06/2017)	1 visit (Silicon Valley, US)
	Visit to Wisemont Capital (06/06/2017)	1 visit (Silicon Valley, US)
	Attendance at Global Silicon Valley Investor Day	Activity attendance (Silicon Valley, US)

	(06/06/2017)	
	Visit to Huawei (07/07/2016 and 19/07/2016 to Shenzhen headquarters, 11/04/2017 to Huawei Bantian base)	3 visits (Shenzhen, China)
	Visit to Foxconn (08/07/2016 to Foxconn Shenzhen base)	1 visit (Shenzhen, China)
	Visit to BGI (08/07/2016)	1 visit (Shenzhen, China)
	Visit to Topray Solar (12/07/2016)	1 visit (Shenzhen, China)
	Visit to Songshanhu Xbot park (13/07/2016)	1 visit (Dongguan, China)
	Visit to Shenzhen Qianhai Financial Holdings (13/07/2016)	1 visit (Dongguan, China)
	Visit to Shenzhen Innovation Fund (14/07/2016)	1 visit (Shenzhen, China)
	Visit to Mindray (14/07/2014)	1 visit (Shenzhen, China)
	Visit to Shenzhen Institutes of Advanced Technology, Chinese Academy of Science (18/07/2016)	1 visit (Shenzhen, China)
	Visit to Shenzhen Technology and Innovation Commission, Shenzhen Development and Reform Commission (19/07/2016)	1 visit (Shenzhen, China)
	Visit to Tencent (19/07/2016 and 29/03/2017 to Tencent headquarters)	2 visits (Shenzhen, China)
	Visit to Han's Laser (20/07/2016)	1 visit (Shenzhen, China)
	Visit to TusPark Space (22/03/2017)	1 visit (Shenzhen, China)
	Visit to Green Pine Capital (23/03/2017)	1 visit (Shenzhen, China)
	Visit to Nectac (24/03/2017)	1 visit (Shenzhen, China)
	Visit to China Merchants Group Shekou Branch (29/03/2017 and 03/04/2017)	2 visits (Shenzhen, China)
	Visit to Midea (30/03/2017)	1 visit (Shunde, China)
	Visit to OPPO (31/03/2017 to OPPO headquarters)	1 visit (Dongguan, China)
	Visit to DJI (31/03/2017 to DJI headquarters)	1 visit (Shenzhen, China)
	Visit to ARM Shenzhen office (31/03/2017)	1 visit (Shenzhen, China)
	Attendance at Ten Year Anniversary of Green Pine Capital (06/04/2017)	Activity attendance (Shenzhen, China)
Focus group	Internal Seminar Discussion on Entrepreneurial Ecosystems (mainly with researchers from the UK and China, 27/03/2018, 21/11/2017, 12/12/2016, 21/03/2016)	4 meeting minutes (40 pages) and Q&A transcriptions (26 pages)
	External Seminar on Cambridge Phenomenon as well as entrepreneurial ecosystems (researchers, practitioners from the UK, October 2017)	1 discussion minute (6 pages) and Q&A transcriptions (8 pages)
	External Workshop on measuring Cambridge Entrepreneurship Performance (researchers, practitioners, and policy-makers, March 2017)	1 discussion minute (6 pages) and Q&A transcriptions (11 pages)
Secondary Data ***Newspaper articles***	Articles pertinent to Silicon Valley entrepreneurship (all available dates)	238 English articles from LexisNexis (Handpicked, excluding high similarity duplications)
	Articles pertinent to Fairchild's entrepreneurial process (all available dates)	16 English articles from LexisNexis (Handpicked, excluding high similarity duplications)
	Articles pertinent to Intel's entrepreneurial process (all available dates)	20 English articles from LexisNexis (Handpicked, excluding high similarity duplications)
	Articles pertinent to Apple's entrepreneurial process (all available dates)	49 English articles from LexisNexis (Handpicked, excluding high similarity duplications)
	Articles pertinent to Google's entrepreneurial process (all available dates)	47 English articles from LexisNexis (Handpicked, excluding high similarity duplications)
	Articles pertinent to Tesla's entrepreneurial process (all available dates)	62 English articles from LexisNexis (Handpicked, excluding high similarity duplications)
	Articles pertinent to Shenzhen entrepreneurship (all available dates)	242 English articles from LexisNexis (Handpicked, excluding high similarity duplications) 220 Chinese articles from Xinhua Multimedia Database
	Articles pertinent to Huawei's entrepreneurial process (all available dates)	42 Chinese articles from Xinhua Multimedia Database
	Articles pertinent to Tencent's entrepreneurial process (all available dates)	48 Chinese articles from Xinhua Multimedia Database
	Articles pertinent to DJI's entrepreneurial process (all available dates)	56 Chinese articles from Xinhua Multimedia Database

Industrial and government reports	Industrial reports regarding Silicon Valley's regional development: Silicon Valley Index 1995-2018	14 reports, 1396 pages
	Shenzhen Science and Technology Innovation Commission series reports	15 reports, 985 pages in Chinese
Books and monographs	Books pertinent to Silicon Valley's development: "Regional Advantage", "Valley of Genius", "The Secrets of Silicon Valley (in Chinese)", "Secrets of Silicon Valley", "A History of Silicon Valley"	5 books, 4302 pages
	Book pertinent to Fairchild-Intel's entrepreneurial process: "Collection of Laoqian (in Chinese)"	1 book, 215 pages
	Books pertinent to Apple's entrepreneurial process: "Collection of Laoqian (in Chinese)", "Steve Jobs"	2 books, 1433 pages
	Book pertinent to Google's entrepreneurial process: "The Google Guys"	1 books, 472 pages
	Book pertinent to Tesla's entrepreneurial process: "Elon Musk"	1 book, 378 pages
	Books (in Chinese) pertinent to Shenzhen's development: "The History of Shenzhen's Entrepreneurship (1979-2009) I and II", "There is a Model Called Shanzhai", "Forty Years' Development of Shenzhen"	4 books, 1920 pages in Chinese
	Books (in Chinese) pertinent to Huawei's entrepreneurial process: "Creating Huawei", "Huawei's Leadership, Culture and Connectivity", "The Truth to Huawei"	3 books, 1162 pages
	Books (in Chinese) pertinent to Tencent's entrepreneurial process: "Tencent Business Insider", "Biography of Tencent", "How Tencent Grew up", "Pony Ma's Internal Seminars"	4 books, 816 pages
Videos, archives, and third-party interviews	Videos regarding Shenzhen's development: "Decoding Shenzhen: Huaqiangbei"	4 videos by CCTV, retrieved from YouTube
	Shenzhen's yearbook	Retrieved from Shenzhen Library
	Third-party interview with DJI's founder, Tao Wang	Interview by Shenzhen Technology and Innovation Commission: 1 interview transcript (20 pages in Chinese)
Websites and related online resources	All interviewed organisations' websites where they exist	N/A
	Articles from reputable English online sources	5 articles from Business Insider, 3 articles from Harvard Business Review, and 3 articles from the economist.com website regarding Silicon Valley's entrepreneurship;
	Articles from reputable Chinese online sources	5 articles from Tencent News, 5 articles from FT Chinese, and 5 articles written by reputable individuals published in WeChat accounts regarding Shenzhen's entrepreneurship
	Documentation and archives obtained from site visits to various organisations	N/A

Some interviews were conducted for two rounds. Usually, interviews with targeted interviewees were conducted on site. Each interview lasted between 30 minutes and 120 minutes. Interview notes were summarised as soon as the interview had finished. Then, the basic facts summarised from the interview would be sent to the interviewee to ensure accuracy and transparency. If necessary, a follow-up interview was conducted to obtain additional information or data on some less clarified or inconsistent topics. Secondary data was also collected from the site visits, including brochures, internal archives, presentation slides and documents relevant to the topic. In total, 74 in-depth semi-structured interviews were conducted, as shown in Table 3-6.

Table 3–6 Interviewee list

Ecosystem	Organisation	Type of Organisation	Position	Interview length
Shenzhen	***Ecosystem Informants***			
	BGI	Start-ups	Vice President	38 min
			Operation Director	59 min
	Han's	Start-ups	Senior Manager	45 min
	Douhe	Start-ups	CEO	65 min
	Crazy Baby	Start-ups	Senior Product Manager	45 min
	Guangxigu	Start-ups	CEO	62 min
	Nectac	SMEs	Senior Manager	78 min
	Topray	SMEs	President	22 min
			Vice President	40 min
	Mindray	SMEs	Director of R&D	85 min
	Foxconn	MNCs	Marketing Director	55 min
			President of FIT	30 min
	OPPO	MNCs	Vice General Manager	65 min
			Director of Administrative Office	56 min
	Green Pine Capital	VC	Business Partner	72 min
	Shenzhen Innovation Fund	VC/PE	Senior Investment Manager	56 min
	ARM Shenzhen office, investment division	Corporate VC	Director of Investment	48 min
	Shenzhen Qianhai Financial	PE	Director of Fund Management	49 min
	Shenzhen Institute of Advanced Technology, Chinese Academy of Science	University/ research institute	Associate Professor, Director of Graduate Studies	90 min
	Shenzhen Graduate School, Harbin Institute of Technology	University/ research institute	Professor in Regional Development	118 min
	Shenzhen Science, Technology and Innovation Commission	Government	Deputy Director	79 min
	Shenzhen Development and Reform Commission	Government	Deputy Director	79 min
	China Merchants Group Shekou	State-owned enterprise	Director of Industry Research	30 min
			Director of Investment and Development	45 min
			Deputy Director of Investment and Development	45 min
	TusPark Space	Incubator	Director of Operations	46 min
			General Manager	35 min
	SZL Xbot Park	Incubator and early-stage investor	Director of Public Relations	104 min
	Chaihuo space	Makerspace, incubator and early-stage investor	Director	90 min
	CVISC	Industry development consulting firm	CEO	110 min
	Entrepreneurial-process Informants			
	Huawei	N/A	Vice President of Public Affairs	45 min
			Personal consultant of Zhengfei Ren	29 min
			Director of Supply Chain Management	70 min
	Tencent	N/A	Senior Product Manager	99 min
			Senior Strategy Analyst	100 min
			Director, Office of CEO	78 min
	DJI	N/A	Director of Public Relations	72 min
			Executive Assistant to CEO	75 min
			Service Strategy Manager	60 min

Silicon Valley	***Ecosystem Informants***			
	Apexigen	Start-ups	CEO	66 min
	Efficient Drivetrain	Start-ups	Co-founder	65 min
	Bluejay Mobile Health	Start-ups	CEO	73 min
	Cloudminds	Start-ups	CEO	91 min
	Midas Touch	Start-ups	CEO	60 min
			CTO	60 min
	Upwork	SMEs	CEO	82 min
	Sigrity	SMEs	Senior Group Director	99 min
	Facebook	MNCs	Senior Product Manager	101 min
	Google	MNCs	Senior Product Manager	51 min
	H&Q Asia Pacific Global Innovation Centre	VC/PE	Managing Director	99 min
	SVC Venture Club	VC/Platform	CEO	63 min
	Wisemont Capital	VC	Founder and CEO	59 min
	British Telecom Silicon Valley Investment office	Corporate VC	Vice President of Technology and Innovation Scouting	95 min
			Managing Director of External Innovation	90 min
	Stanford University	University/ research institute	Professor, Centre for Sustainable Development and Global Competitiveness	112 min
	IBM Research – Almaden	University/ research institute	Research Group Leader	88 min
			Director, Cognitive Systems	66 min
			IP counsellor	71 min
	Sunnyvale City Council	Government	Council Member	76 min
	Ufrate	Incubator	CEO	89 min
	Institute of Industrial Technology	Incubator	Director	43 min
	ZGC Innovation Centre	Incubator	Director	54 min
	SVInsight	Entrepreneurship and technology media	Co-founder	77 min
	Entrepreneurial-process Informants			
	Fairchild-Intel	N/A	Senior Engineer (30+ years experiences working in electronics industry in Silicon Valley)	77 min
	Apple	N/A	Senior Project Manager (Interviewed twice)	78 min, 40 min
			Senior Hardware Manager	45 min
	Google	N/A	Senior Software Engineer (Interviewed twice)	69 min, 44 min
			Network Security Engineer	64 min
			Senior Android Engineer	58 min
	Tesla	N/A	Senior Strategy Analyst (Interviewed twice)	71 min, 41 min
			Senior Business Development Manager	69 min

3.3.2 Data collection protocol

Data collection was conducted as two phases, as is illustrated in Table 3-7. The first phase was to collect ecosystem-level data by interviewing different players in the entrepreneurial ecosystems. This data includes the historical and current perspectives of the entrepreneurial

ecosystems, as well as the interactions between different players in the ecosystems and how they benefit from the ecosystems. Before entering the field for first-phase data collection, secondary data including newspaper articles, books and industrial/government reports about Shenzhen and Silicon Valley development were compiled in order to understand the background. At the end of the first phase, the evolutions of Shenzhen and Silicon Valley were mapped out. During the mapping, interview data was triangulated with secondary data. Based on the evolutionary mapping which demonstrates the key events over time, the key entrepreneurial firms mentioned in 3.1.5 were identified.

The protocol for ecosystem informants comprises four sections: (1) key contexts of the interviewed organisations within the entrepreneurial ecosystems, (2) the interactions of the interviewed organisations with other players in the ecosystems, (3) key events of the interviewed organisations along their development, and (4) how the EE benefits the interviewed organisations in different events. With these sections, it is possible to cover related topics on decomposing entrepreneurial ecosystem health, to answer research sub-question 1 and partly answer research sub-question 3. As a broad range of interviewees from many different but related organisations were involved, this protocol has been tailored to fit with different types of organisations and interviewees.

With the key entrepreneurial firms identified in each ecosystem during different stages of development, the second-phase data collection started. Similarly, before entering the field, secondary data including newspaper articles, books and monographs, as well as videos and third-party interviews regarding key entrepreneurial firms was compiled in order to understand the backgrounds and prepare the interviews.

The protocol for entrepreneurial-process informants comprises three sections: (1) key contexts of the organisations and the ecosystem at the time of their entrepreneurial processes, (2) key challenges faced in different stages of entrepreneurial processes, and (3) ecosystem's impacts on the challenges faced. These sections are sufficient to yield answers to the second and third sub-research questions.

Table 3–7 Data collection protocol

Sub-research questions	Data to be collected	Key interview questions	Secondary data used
For ecosystem informants ***What are the dimensions of entrepreneurial ecosystem health?*** ***How does a healthy entrepreneurial ecosystem facilitate new venture creation processes?***	Key contexts and roles of the interviewed organisations within the entrepreneurial ecosystems	What attracts you to establish yourself in the ecosystem? What do you think of your role in the entrepreneurial ecosystem?	Interviewee organisations' websites where they exist; Brochures and other documents obtained from the organisations
	The interactions of the interviewed organisations with other players in the ecosystems	What do you offer (services or products or other benefits) specifically for other players in the ecosystem? Why? Demonstrate examples What do you receive (services or products or any other benefits) from other players in the ecosystem, and Why? Demonstrate examples What are the key factors for other players in the ecosystem to be able to access the services or products you are offering to them? What are the key factors for you to be able to access the services or products other ecosystem players offer?	Interviewee organisations' websites where exist; Brochures and other documents obtained from the organisations, News articles, books and monographs where possible
	Key events and incidents of the interviewed organisations along their development How the ecosystem benefits the interviewed organisations in different events	Describe the major incidents and events you have come across during your development What were the major challenges you faced when an incidents or event occurred Did your interactions with other players in the ecosystem help you go through the challenges? If yes to the first question, demonstrate examples If not, describe what the ecosystem should have offered you at that time	Interviewee organisations' websites where exist; Brochures and other documents obtained from the organisations, News articles, books and monographs where possible
For entrepreneurial-process informants ***How do individual entrepreneurial activities contribute to collective entrepreneurial ecosystem health?*** ***How does a healthy entrepreneurial ecosystem facilitate new venture creation processes?***	Key contexts of the organisations and the ecosystem at the time of their entrepreneurial processes	What was the founder's intention in setting up this organisation? What were the key backgrounds of the industry and the business environment of the ecosystem at the time of founding?	Interviewee organisations' websites; Brochures and other documents obtained from the organisations, News articles, books and monographs, founders' biography where possible
	Key challenges faced in different stages of entrepreneurial processes	What were the key challenges in the opportunity stage? What were the key challenges in the organisation and technology set-up stage? What were the key challenges in the beginning of market exchange?	Interviewee organisations' websites; Brochures and other documents obtained from the organisations, News articles, books and monographs, founders' biography where possible
	Ecosystem's impacts on the challenges faced	Did the founding team acquire any resources from the ecosystem during the founding process? And if so, how did they obtain various resources during different stages? To what extent do you think the resources obtained from the ecosystem helped the founding team overcome key challenges in different stages?	Interviewee organisations' websites; Brochures and other documents obtained from the organisations, News articles, books and monographs, founders' biography where possible

3.4 Data analysis

The data analysis of this dissertation involves three types of approaches: process data analysis for making sense of the initial primary and secondary data, inductive coding for entrepreneurial ecosystem health, and cross-case analysis when deriving resource dynamisms in relation to the entrepreneurial ecosystems' support for new venture creation activities.

Strategy	Key Anchor Point(s)	Exemplars	Fit with Process Data Complexity	Specific Data Needs	"Good Theory" Dimensions (Weick)	Form of Sensemaking
Narrative strategy	Time	Chandler (1964) Bartunek (1984) Pettigrew (1985)	Fits with ambiguous boundaries, variable temporal embeddedness, and eclecticism.	One or few rich cases. Can be helped by comparison.	High on *accuracy*. Lower on *simplicity* and *generality*.	Stories, meanings, mechanisms
Quantification strategy	Events, outcomes	Garud & Van de Ven (1992) Van de Ven & Polley (1992)	Focuses on "events" and their characteristics. Eschews ambiguity.	Needs many similar events for statistical analysis: one or few dense cases is best.	High *simplicity*, potentially high *generality*, modest *accuracy* (abstraction from original data).	Patterns, mechanisms
Alternate templates strategy	Theories	Allison (1971) Markus (1983) Pinfield (1986) Collis (1991)	Adaptable to various kinds of complexity. Different templates capture different elements.	One case is enough. Degrees of freedom come from multiple templates.	Each theory can be *simple* and *general*. Together, they offer *accuracy*, but *simplicity* and *generality* disappear with theory integration.	Mechanisms
Grounded theory strategy	Incidents (units of text) Categories	Sutton (1987) Isabella (1990) Gioia, Thomas, Clark, & Chittipeddi (1994)	Adapts well to eclectic data and ambiguity. May miss broad high-level patterns.	Needs detail on many similar incidences. Could be different processes or individual-level analysis of one case.	High on *accuracy*, moderate *simplicity*. May be difficult to go from substantive theory to more *general* level.	Meanings, patterns
Visual mapping strategy	Events, orderings	Meyer (1984, 1991) Nutt (1984, 1993) Langley & Truax (1994)	Deals well with time, relationships, etc. Less good for emotions and interpretations.	Needs several cases in moderate level of detail to begin generating patterns (5–10 or more).	Moderate levels of *accuracy*, *simplicity*, and *generality*. Not necessarily good at detecting mechanisms.	Patterns
Temporal bracketing strategy	Phases	Barley (1986) Denis, Langley, & Cazale (1996) Doz (1996)	Can deal with eclectic data, but needs clear temporal breakpoints to define phases.	One or two detailed cases is sufficient if processes have several phases used for replication.	*Accuracy* depends on adequacy of temporal decomposition. Moderate *simplicity* and *generality*.	Mechanisms
Synthetic strategy	Processes (e.g., decisions, change efforts, new products)	Eisenhardt (1989a; with Bourgeois, 1988) Meyer & Goes (1988)	Needs clear process boundaries to create measures. Compresses events into typical sequences.	Needs enough cases (5+) to generate convincing relationships. Moderate level of detail needed for internal validity.	Modest *accuracy* (but much better than questionnaire research). Can produce *simple* and moderately *general* theories.	Prediction

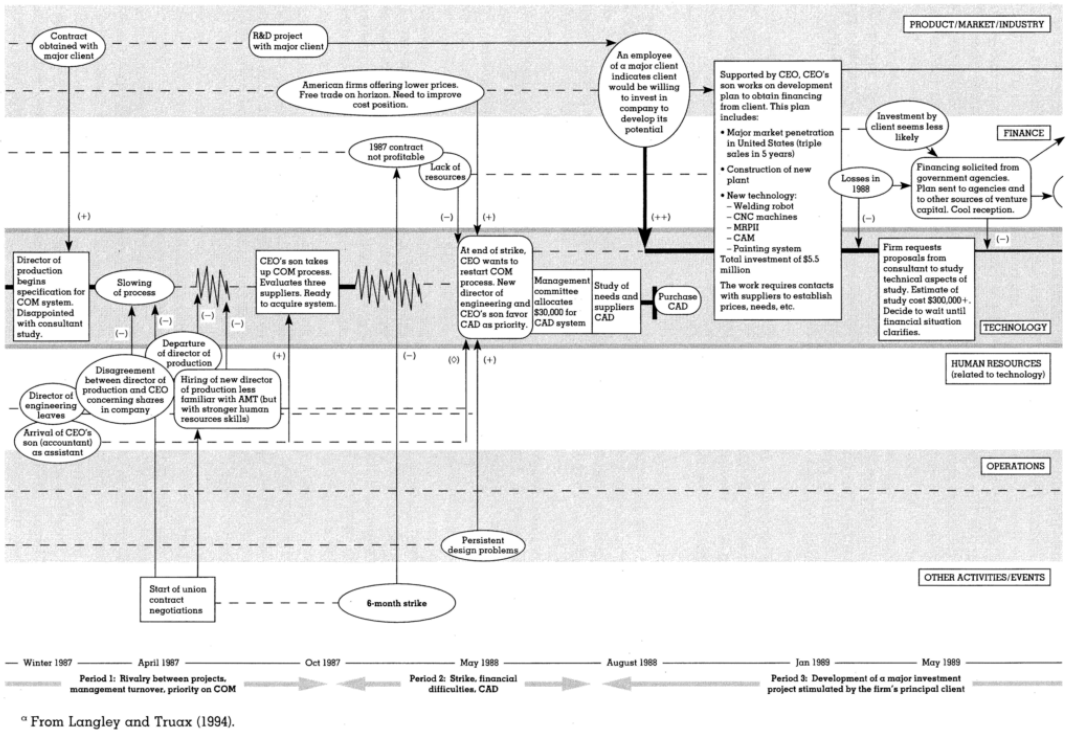
[a] Note that the entries in this table are indicative only. There is obviously considerable variation amongst the research following each strategy.

Figure 3–3 Seven strategies for sensemaking (Langley, 1999)

3.4.1 Process data analysis

As per the data collected in phase one, an evolutionary process is identified for both ecosystems, which fits into what Van de Ven and Poole (1995) have described as an evolutional model of development. Therefore, to make sense of this data, suggestions made by Langley (2011, 2013) were adopted in analysing the process data, as can be seen in Figure 3-3. Specifically, the narrative strategy (Langley, 1999) was first adopted to describe the evolution and development

of both ecosystems, as the embedded case design offers rich data within one main case. Further, to simplify the storylines and increase the potential for cross-case comparison and generalisability, a visual mapping strategy (Langley, 1999) was employed, as is illustrated in Figure 3-4, incorporating suggestions made by Phaal *et al.* (2011) in terms of technology road-mapping. During the evolutionary mapping of the cases, the author set out to explore the key events and incidents that could enable the temporal bracketing strategy to be applied (Langley, 1999) to specify different phases of development of both ecosystems.



[a] From Langley and Truax (1994).

Figure 3–4 Extract from a process flowchart (Langley, 1999)

Notably, the mapping of entrepreneurial ecosystems follows Isenberg (2011) as well as Mack and Meyer (2016) regarding the elements of entrepreneurial ecosystems – policy, finance, markets, human capital, supports and culture – in order to ensure key events during the development of the ecosystems were not left out. The mapping of entrepreneurial processes focused on the interactions between start-ups and ecosystems, and also considered industrial key events which might take place outside of the ecosystems. After process data analysis, an inductive coding approach was used to analyse the data collected in phase one.

3.4.2 Inductive coding

Following Gioia's suggestions (Gioia *et al.*, 2012), a three-level coding was conducted to analyse all data. In the first stage, open coding was conducted in order to group together the most frequently mentioned phrases, through which the first-order coding was obtained. In the second stage, the author began to search for the potential relationships between different concepts and merged them into axial codes, which are illustrated in Figure 5-1 as second-order themes. The last stage in coding is theoretical coding, during which axial codes were converted into theoretical accounts. With this approach, data was linked to theories. The theoretical coding has grouped all categories in axial codes into aggregated dimensions, which enabled the author to consider contextual factors to fully understand these constructs. These theoretical codes are illustrated in the data structure as aggregated dimensions. The data analysis process was iteratively repeated until no further new codes could be derived from the data. In this sense, theoretical saturation is reached (Eisenhardt, 1989).

3.4.3 Cross-case analysis

After phase two data collection, data obtained for entrepreneurial processes within each main case ecosystem was analysed, following Eisenhardt's suggestions of cross-case comparisons (Eisenhardt, 1989; Hannah and Eisenhardt, 2018), and Miles and Huberman's cross-case displays (Miles and Huberman, 1994). Specifically, the author compared across different phases of ecosystem evolution, how start-ups in different stages of their entrepreneurial processes access resources from the entrepreneurial ecosystems, as well as the resultant resource dynamisms on the ecosystems, as can be seen in Table 6-1. This cross-case comparison offers insights into how resource dynamisms in the individual entrepreneurial process are linked to those in ecosystem levels, and ultimately contribute to developing an integrative process model regarding how entrepreneurial ecosystems facilitate new venture creation, collectively with the key dimensions of ecosystem health obtained in phase one.

3.5 Summary

In Chapter 3, research design employing a multiple embedded case design is adopted, with two levels of unit of analysis being ecosystem-level and entrepreneurial firm-level. Silicon Valley and Shenzhen have been selected as the case regions and their respective entrepreneurial firms in different time frames have also been identified. Primary data including site visits and interviews with key informants in both regions, and secondary data including books, websites and biographies etc. were used in the analysis. This dissertation combined process data analysis, inductive coding and cross-case analysis to answer the sub research questions raised in Chapter 2.

4. Case Studies: Silicon Valley and Shenzhen Entrepreneurial Ecosystems

> *Why isn't Airbus' global innovation centre in Europe [but in Silicon Valley] or its China innovation centre in Tianjin [but instead in Shenzhen]? The answer is that the real value in a jetliner isn't the aluminium tube of the body or the sleek aeronautics of the wings. It is in the electronics, everything from the avionics that control fuel consumption to the onboard Wi-Fi and entertainment systems. And tomorrow the value will be in the networks that link it all together.*
> *Salvatore Babones, Wall Street Journal*[8]

4.1 Introduction

This chapter provides an account of the evolution of Silicon Valley and Shenzhen's entrepreneurial ecosystems. Note that the account is compiled using both primary data and secondary data, details of which can be referred in Chapter 3. It also examines the entrepreneurial processes of key entrepreneurial firms in different phases as well as their interactions with the ecosystems over time. The case descriptions serve as a basis for further data analysis in Chapter 5, 6 and 7.

4.2 Silicon Valley entrepreneurial ecosystem

This section starts with an overview of the Silicon Valley entrepreneurial ecosystem's development, providing historical and current accounts. It then documents the entrepreneurial processes of key companies in different stages of Silicon Valley ecosystem's development.

---

[8] https://www.forbes.com/sites/salvatorebabones/2017/11/21/shenzhen-and-silicon-valley-are-merging-into-one-giant-makers-hub-call-it-calichina/#68d63ad42251

4.2.1 Silicon Valley EE overview: historical and current accounts

Silicon Valley refers to the southern part of the San Francisco Bay Area in northern California, including Santa Clara, San Jose, Mountain View and Palo Alto right up to San Francisco, as well as the eastern Bay Area such as Berkeley and Oakland, etc. It is the world's innovation centre and the headquarters of over 30 companies listed on the Fortune 500. The word 'Silicon' reveals its specialisation – it is home to a large number of high-tech companies whose products are based on silicon chips. With strong research & development capabilities due to the presence of many world-renowned research institutes such as Stanford University, California Berkeley and IBM research, and one-third of the US's venture capitalists, Silicon Valley has become a vibrant entrepreneurial ecosystem and is attracting talents from all over the world.

Silicon Valley's evolution can be divided into five phases, as is illustrated in Figure 4-1. The genesis of the Silicon Valley ecosystem dates back to the early 20th century when the US government invested hugely in defence. The establishment of Stanford Industrial Park by Frederick Terman, the dean of the School of Engineering at Stanford University, after World War II marked the initiation of Silicon Valley's ecosystem development. In the 1950s, the newly invented silicon transistors led to the establishment of William Shockley's semiconductor lab, and the later Fairchild Semiconductor, which initiated the emerging phase of Silicon Valley. In the third phase, Silicon Valley ecosystem migrated to the fast-growing stage – the creation and accumulation of various resources accelerated, as Intel, together with Fairchild's many other descendants, further developed integrated circuits (ICs) and produced the world's first microprocessors, which effectively created the personal computer (PC) industry. Silicon Valley took off after then. The prospects of the ICT industry in Silicon Valley were further boosted by the mature of venture capital firms and a few later well-known firms were established in this period such as Apple. With a solid foundation in this industry, Silicon Valley entered the mature stage with a leading position in the software sector and Internet sector. Although the Internet bubble burst in 2000, Silicon Valley has renewed itself by leveraging the mobile Internet since 2007. To date, Silicon Valley remains the best technology entrepreneurship region and has consistently generated impactful start-ups.

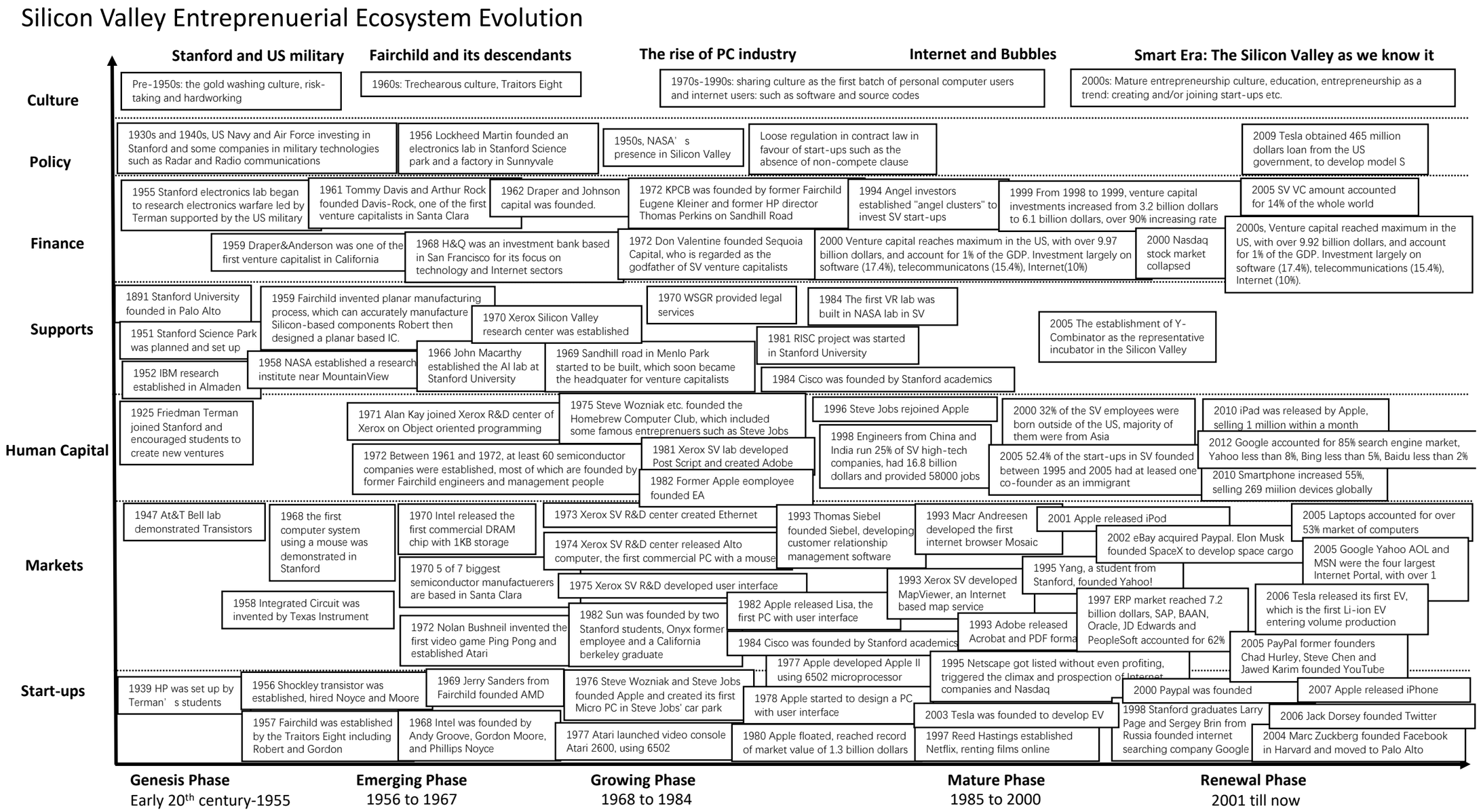


Figure 4–1 The evolution of the Silicon Valley entrepreneurial ecosystem

Genesis: Stanford and the US military (early 20th Century-1955)

The genesis of Silicon Valley dates back to the early 20th century, when the US military was searching for new technologies and applications that could help them win any future wars. In 1933, the US Navy set up a military base in San Francisco and they were looking for radio communication applications that could be used between different ships in the US Navy's fleets. The US Navy began to fund projects in Stanford and a few defence contractors in this area. World War II heightened the investments as the US Air Force was trying to deploy radar in its aircraft carriers as well as in its air defence. Subsequently, some famous defence contractors invested in and set up their factories in Silicon Valley. In 1939, NASA founded the Ames Research Center at the Moffett Federal Airfield in Mountain View, which was a major research centre for NASA. In 1952, IBM's Almaden research centre was established, bringing in top engineers and scientists to the region. In 1956, Lockheed Martin founded an electronics lab in Stanford Industrial Park and a factory in Sunnyvale. These military-funded projects and research institutes nurtured the first batch of electronic component suppliers and manufacturers, as well as top-tier engineers and scientists in Silicon Valley. Besides the military presence, the genesis of Silicon Valley should also be credited to the support from Stanford University.

Although Stanford University was established in 1891, it was not until Terman's presence at Stanford that it began to have significant impacts on the region. When Terman, who was born into a Stanford professor's family in 1900, finished his PhD in electric engineering from Massachusetts Institute of Technology, he decided to join his alma mater – Stanford – as a faculty member. Terman's hard work in electronic engineering and telecommunications gained considerable reputation for Stanford and he was subsequently appointed as the dean of the School of Engineering. The Great Depression in 1929 made Terman contemplate how the university could collaborate with and impact real-world industries beyond pure academic research. This was the beginning of his efforts in facilitating technology transfer and commercialisation from Stanford's research. He often encouraged students to set up their own ventures and led them to visit the earliest local electronic ventures, which helped the students gain hands-on experiences outside of textbooks. Hewlett Packard (HP) was established in 1939

by two of Terman's students, under his initial support; he borrowed $1000 from a local military supplier for HP. Although HP turned out to be extremely successful in the following year, Terman was determined to institutionalise the collaboration of industry and university. He persuaded the then president of Stanford to set up the Stanford Industrial Park, the world's first industrial park set up by a university, and let the land beside Stanford in Palo Alto to many different types of research institutes, companies and labs. The industrial park was highly successful in terms of encouraging new venture creation activities, especially for commercialising technologies born in the Stanford labs. By 1980, the park had 90 companies and housed some 250,000 employees. The high returns from the leasing contracts helped Stanford to further attract the best academics and professors, particularly in electronics and computer science, later on, which formed a positive feedback loop in laying down the foundation for the electronics industry in Silicon Valley.

On the other side of the US, William Shockley, John Bardeen and Walter Brattin in AT&T's Bell lab invented silicon transistors in 1948, which were further developed for scale manufacturing. In the 1950s, when the high-purity silicon manufacturing method was mature, Shockley thought of starting a new industry with his new technologies and believed that the dry climate in his hometown in northern California might serve as a good place. Terman and Shockley discussed the possibility of his returning to Stanford and Terman persuaded him to set up his new venture beside Stanford. The birth of Shockley Transistors opened up a new phase for Silicon Valley.

Emerging: Fairchild and its descendants (1956-1971)

Although Shockley Transistors could be regarded as the origin of nearly all other subsequent semiconductor companies in Silicon Valley, the company was not very successful. Shockley may have been a good researcher, but he struggled to be a good leader for his own company – especially after he was awarded the Nobel Prize for his invention of silicon transistors; after this, Shockley became even more self-righteous and failed to take in any advice raised by top scientists he himself had recruited from the East Coast to his lab. When scientists Robert Noyce

and Gordon Moore diverged with Shockley in terms of the technological roadmap of silicon transistors, they decided to set up their own company to fulfil their vision. Together with other six co-founders who were also from Shockley's lab, collectively known as 'Traitors Eight', they established Fairchild in 1957.

When Fairchild invented the planar manufacturing process in 1959, which significantly increased the accuracy in manufacturing silicon-based components, the company reached a historical high in terms of sales. However, soon after that, the Traitors Eight had conflicts with the parent company on the East Coast of the US and gradually left the company. Fairchild's spinning-off journey had started. The first spin-off company was Rheem in 1959, which was founded by Ed Baldwin, the then general manager of Fairchild, leading to the future trend of spinning-off in the company, as is shown in Figure 4-2. In 1961, Jay Last, Jean Hoerni and Sheldon Roberts, three of the Traitors Eight, left Fairchild and founded Amelco. In the same year, Signetics was founded by four former Fairchild engineers, and Molectro, a later competitor of Fairchild, was founded by Jim Nall and D. Spittlehouse, who were formerly employed by Fairchild. In 1968, Intel was founded as Gordon Moore and Robert Noyce envisioned the use of integrated chips for personal computers. Jerry Sanders, former sales director of Fairchild, led seven former Fairchild employees to found AMD, which later became the second largest chip provider (and competitor with Intel) after Intel.

By 1972, at least 60 semiconductor companies had been established in Silicon Valley, most of which were founded by former Fairchild engineers and employees. William Shockley, and Fairchild – established by the Traitors Eight from Shockley's lab – as well as its numerous descendants essentially facilitated the emergence of Silicon Valley.

Fairchild-Intel's contribution to the entrepreneurial ecosystem is far more than spin-offs and technologies alone. The venture capitalist industry was essentially created by the establishment of Fairchild. Funded by Arthur Rock and an East Coast parental company, the Traitors Eight signed the first venture capital deal and created a new approach to investment – technology holders could exchange their technologies for shares in the start-ups. The venture capitalist

industry emerged. Rock went on to establish the Davis & Rock venture capital firm in 1961, one of the first such firms in Silicon Valley. Another later famous venture capitalist company, Draper & Anderson was founded in 1959. One of the Traitors Eight, Eugene Kleiner, decided to enter the venture capital industry himself. He found KPCB on Sand Hill Road, the world-renowned venture capitalist road, together with former HP director Thomas Perkins. Apart from the creation of the venture capitalist industry, Intel is the first company that distributed shares to employees before floating. When Intel floated in 1971, many early employees became millionaires and some of them chose to reinvest their money in other start-ups, which further boosted the development of financing for start-ups. This innovation was then imitated by other Silicon Valley companies and later by start-ups worldwide, as a way to encourage talents to join start-ups with a vision of making considerable profits compared to traditional professions.

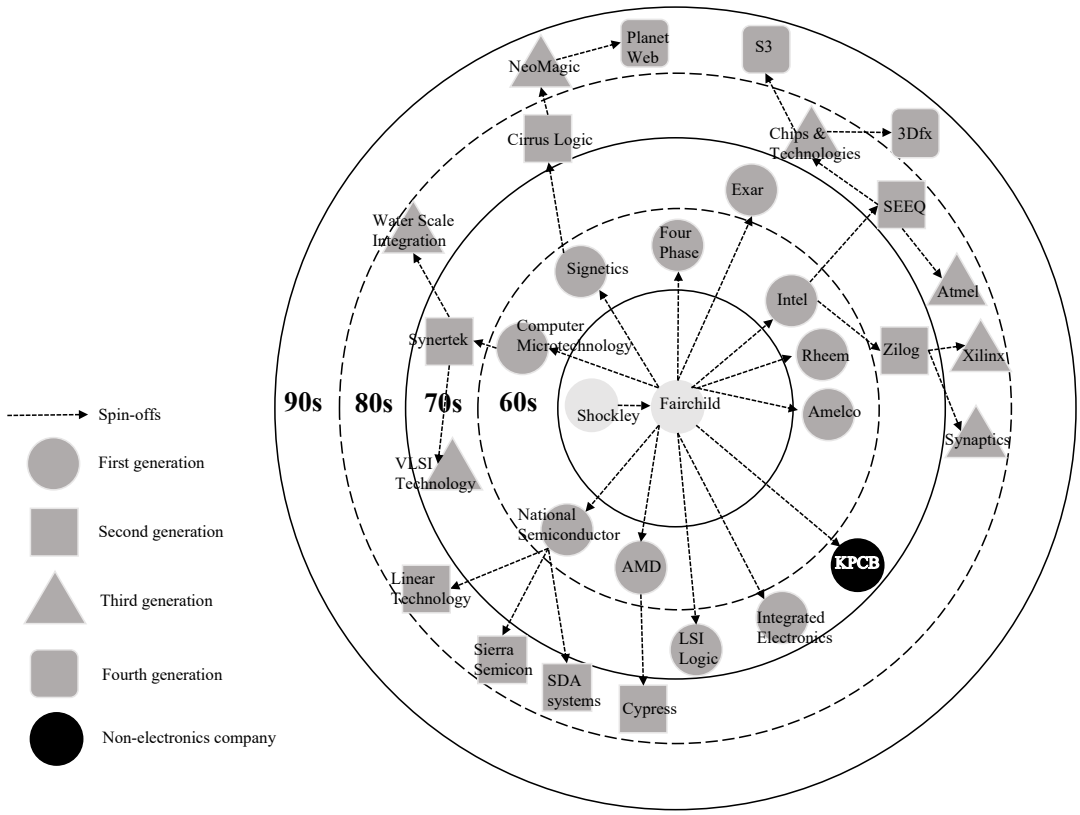


Figure 4–2 The spin-offs of Fairchild

When Intel's first commercial microprocessor, 4004, was released in 1971, which included DRAM 4001, ROM 4002 and Register 4003, Silicon Valley was ready for the next growth phase: the rise of personal computers.

Growing: The rise of the PC industry (1972-1990)

The beginning of the 1970s marked the emergence of the PC industry in Silicon Valley. Although Douglas Engelbart, a researcher in the Augmentation Research Center at Stanford Research Institute, demonstrated the first personal computer in 1968 with a mouse and user interface, etc. However, it was not until Intel's release of 4004, the first commercial microprocessor in a personal computer, that the PC industry started to take off.

Silicon Valley's PC industry was further propelled by companies like Atari and Apple. Nolan Bushnell invented the first video game console, using Intel's 4004 microprocessors, which led to the establishment of Atari in 1972. Interestingly, Steve Jobs, the co-founder of Apple, had an internship in Atari, and was highly appreciated by Bushnell. When Jobs and Steve Wozniak aspired to create Apple computers, Bushnell connected them to Don Valentine, the founder of Sequoia, one of the biggest venture capitalists in Silicon Valley and worldwide. In 1976, Apple was established by Jobs and Wozniak in Jobs' garage. The creation of Apple also benefitted from the creation and accumulation of essential resources including supporting infrastructure in the ecosystem. For example, Wozniak and Jobs demonstrated their prototypes to a local computer society called the Homebrew Computer Club. They received feedback on their product and gained the first order for Apple II, as well as successfully hiring several engineers they met at the club. Also, the growing venture capitalist community in Silicon Valley provided more options for Apple to gain investment from, compared to the new ventures in the emerging phase, as the most famous venture capitalists in Silicon Valley were all established by the mid-1970s, such as KPCB and Sequoia.

The role played by the Xerox research centre in this phase, which was established in Silicon Valley in 1970, was also notable. Although Xerox was not commercially successful in terms of their products in the PC industry, they had numerous inventions relating to personal computers. For example, Xerox invented the first User Interface that was widely used from the 1980s in all personal computers. Their prototype 'Alto computer' inspired Jobs, after his visit to the research centre in 1979, to create Macintosh in 1984, a revolutionary personal computer that

comes with a mouse and user interface, which became the dominant design of personal computers. Xerox also created the world's first local networks, which they called Ethernet; the famous Portable Document Format (pdf) was also created and standardised by the Xerox research centre, which later led to the spin-off of Adobe.

The flourishing PC industry stimulated the development of the software sector in Silicon Valley, especially commercial software, for instance, the relational database. In 1970, an IBM researcher published the theory of relational database. Several years later, IBM released the SQL (Structured English Query Language) to improve the efficiency of looking up information in a relational database. At that time, the theories of relational database did not draw much attention, as there were simply not enough computers and data that needed to be managed in an efficient way. However, in the 1980s, the number of personal computers and the amount of data accumulated increased the demand to manage data more efficiently and effectively. Larry Ellison, the founder of Oracle, was inspired by the IBM research paper and set out to commercialise the relational database. Oracle was established in 1984 and soon achieved huge success in the market – in less than 10 years' time, Oracle grew to become a billion-level company.

The growing number of personal computers and the need to connect them brought Silicon Valley to the next phase: Internet and the subsequent bubbles as the mature stage of Silicon Valley's entrepreneurial ecosystem.

Mature: Internet and bubbles (1991-2006)

As the World Wide Web first appeared in 1991, the Internet industry began to grow rapidly. Following its leading position in the PC and related industries, Silicon Valley's ecosystem continued to nurture new and impactful ventures in the Internet industry: in 1995, two Stanford graduates, Jerry Yang and David Filo, created Yahoo! in Sunnyvale, a web portal and search engine which was later expanded to other related areas such as email systems and social media. The creation of eBay in 1995 started e-commerce. In 1998, Google was established by another two Stanford graduates, Larry Page and Sergey Brin; it is a search engine based on the

PageRank system. In 2004, Facebook was established at Harvard University but was soon relocated to Palo Alto by its founder, Mark Zuckerberg.

This series of sustained new venture creation activities is built upon the mature entrepreneurial ecosystem in Silicon Valley by 1990s: culturally, Silicon Valley has always been a particularly friendly and tolerant region for entrepreneurship. Its legal system is favourable to start-ups, for instance, job-hopping to competing companies is loosely regulated without the non-compete clause in contract law. Financial support is readily available – specialised venture capitalists with a clear division of different venture stages such as Angel investment and seed funding, rounds A, B, C, etc., right up to Initial Public Offering (IPO). Markets are mature, with leading companies such as Intel, Apple, Oracle and Cisco, and universities such as Stanford and UC Berkeley acting as hubs for innovation and attracting talents, as well as new ventures testing new business models and technologies Support is prevalent in Silicon Valley, with numerous incubators such as T-Combinator and legal service providers for start-ups such as WSGR. The talent pool grows rapidly with immigrants – particularly from countries like India and China – providing the sufficiently proficient and high-quality engineers required for product development.

However, the fever of Internet companies in the capital market did not last long, as the Internet bubble burst in 2000 and the Nasdaq collapsed. The Silicon Valley ecosystem recovered from the shock, but not by sticking to the old path. Instead, the ecosystem renewed itself following the disruptive emergence of the mobile Internet.

Renewal: Smart era and Silicon Valley as we know it (2007-Now)

Although the mobile phone industry dates back to the 1980s when Motorola popularised its first-generation cell phones, it was not until Nokia's Symbian system that mobile phones were connected with the Internet. However, the most impactful disruption was brought by Apple's release of its iPhone in 2007. As the first genuinely 'smart' phone, the iPhone started the smart era: the sharpened integration of hardware and software, mobile Internet-based services, as well as the surge of platform economy.

On the basis of the existing mature resource base of the entrepreneurial ecosystem, new business models and technological applications continue to flourish in Silicon Valley, leveraging the mobile Internet technologies to disrupt existing industries. For example, the development of Tesla, founded in 2003, has leveraged the computational power and cloud storage embedded within the electric vehicle, as well as its superior battery management systems to maximise the battery life and other related driver experiences, disrupting the automobile industry. The new sharing economy, such as Uber and Airbnb in the late 2000s, has challenged the traditional car-hailing and hospitality industries respectively. Looking back to the past phases of Silicon Valley ecosystem's development, in some sense, there were not many inventions. Instead, the Silicon Valley ecosystem is proficient at commercialising technologies that may or may not be invented elsewhere and using these technologies to disrupt existing industries. However, Silicon Valley did invent a lot of things in another sense, as it keeps reinventing and disrupting itself with different enabling technologies in different phases of development. Essentially, none of these would work without the underlying ecosystem behind Silicon Valley.

4.2.2 Fairchild-Intel's entrepreneurial process (1956-1974) and interaction with the EE

The story of Fairchild and Intel dates back to the establishment of Shockley Transistors. In 1956, William Shockley established this company producing transistors, with which he won the Nobel Prize. In the beginning, he hired the later renowned 'Fairchild Eight', including Robert Noyce and Gordon Moore, and focused on research and development of the next generation transistors to be used in computers. However, the Nobel Prize Laureate turned out to be a mediocre manager and he soon lost the trust of his best employees. Noyce and Moore, who were leaders of the Fairchild Eight, disagreed with Shockley on the future developmental avenue of transistors and decided to start their own companies to fulfil their ambitions.

They soon found that they had all the technologies but no money; 1950's Silicon Valley did not have venture capitalists (precisely nowhere did) as we know them today. The Fairchild co-

founders had to look for help from the east – Eugene Kleiner, one of the co-founders, wrote to his father's account manager about their venture, a letter eventually seen by Arthur Rock. Rock flew to San Francisco to meet the co-founders and they finally agreed upon an investment deal. In 1957, Noyce and Moore, together with the other six cofounders, resigned from Shockley Transistors and established Fairchild in Mountain View, sponsored by Rock and the parent company, Fairchild Camera and Instrument Corp. It was the first venture capital fund ever in the Bay Area and paved a new approach to investment – technology holders could exchange their technologies for shares in the start-ups they set up.

Fairchild's first contract was from IBM in 1958, as the parent company on the East Coast was one of the shareholders of IBM. After that, Fairchild electronics grew rapidly. In 1959, Fairchild invented the planar process, which aided more accurate production of silicon components. Subsequently, Noyce designed a planar-based integrated circuit board, which helped the company take off. In 1960, Fairchild recorded sales of $21 million and was the eighth largest player in this industry. It also started to manufacture its own integrated circuits (ICs), when ICs started to be used in computers.

In the meantime, Fairchild's spinning-off journey started. The first spin-off company was Rheem in 1959, leading to a future trend of spinning-off in the company. In 1961, Amelco was founded by three of the Traitors Eight, Jay Last, Jean Hoerni and Sheldon Roberts. Hoerni would go on to found another 12 companies. Interestingly, Amelco was also sponsored by Rock. When Last told Rock that he was not happy in Fairchild and intended to set up a new company, Rock immediately introduced him to Teledyne, a semiconductor company providing components for the military. In the same year, Signetics was founded by four former Fairchild engineers, and Molectro, a later competitor of Fairchild, was founded by previous Fairchild employees Jim Nall and D. Spittlehouse. Eugene Kleiner, who initially attracted investments for Fairchild, finally decided to enter the venture capital industry himself. He would found KPCB, the world-renowned venture capital firm. In this spin-off trend, Tommy Davis and Arthur Rock founded one of the first venture capital firms in Santa Clara. The company received money from Fairchild co-founders to continue investing in new promising companies,

including those spinning-off from Fairchild.

In the early 1960s, Fairchild enjoyed high growth. As demand for computer chips grew, Noyce persuaded Moore that integrated chips could be the future and would replace individual separate processing units, and, as a result, Fairchild invested more on chip design and production. In 1963, Fairchild became the number three player in this industry and opened its first overseas assembly plant, in Hong Kong. By 1966, the company was ranked second in the industry, encompassing TI and Motorola, and employed over 4000 people. However, the long-standing conflicts with its parent company on the East Coast in terms of value distribution had strengthened as the company continued to grow. Many senior employees set out to start their own companies, including Intel. It is estimated that, between 1961 and 1972, at least 60 semiconductor companies were established, mostly by former Fairchild employees. In 1968 and 1969 alone, 13 semiconductor companies were established in northern California, eight of which were founded by former Fairchild employees. In 1969, at a semiconductor conference held in Sunnyvale that assembled most of the senior managers in this industry in Silicon Valley, only 24 out of the 400 attendants had nothing to do with Fairchild.

In 1967, the then general manager of Fairchild left for National Semiconductors, moved its headquarters from Connecticut to Silicon Valley, and made it the sixth largest semiconductor company globally. The team also included Valentine, who later found the famous Sequoia Capital. Perhaps nothing can be compared to the movement away of Fairchild's core team. In 1968, Intel was founded by Andy Groove, Gordon Moore and Robert Noyce, and invested in to the tune of $2.5 million by Rock and 25 other investors, including the other five Traitors Eight. Noyce mainly handled marketing and Moore was in charge of the company's operations and technologies. Jerry Sanders, former sales director of Fairchild, led seven former Fairchild employees to found AMD, which later became the second largest chip provider (and competitor with Intel) after Intel. As the competition increased and it lost its core management team, Fairchild's revenue dropped by 95% and profit dropped from three million to $130,000, and the company gradually faded away. However, the foundations it lay down for the semiconductor industry and the whole Silicon Valley persisted.

Built upon the early success of Fairchild, Intel started by developing the Central Processing Units (CPUs) used in computers. Gordon Moore, who proposed the famous Moore's Law that predicts the processing ability of computers would double every 18 months, led the project. Intel also hired new engineers from Stanford University, including Ted Hoff, who was an electronics expert specialising in computer sciences and who made a great contribution to Intel's success in the CPU market. Intel went on to raise second- and third-round financing from investors and venture capitalists in Silicon Valley to support its R&D. In 1971, Intel's first commercial microprocessor, the 4004, was released. The new product quickly inverted the market as every computer company except IBM had adopted this design by the end of 1971.

In 1971, Intel floated on the stock market at $23.5 per share and 300,000 shares. More interestingly, Intel is the first company that distributed shares to its employees before floating; this was imitated by other Silicon Valley companies and later by start-ups all over the world. In 1972, Intel's 8008 and 1103 microprocessors made the company the leader of the chip industry. Further, the 8088 microprocessors, for the first time, adopted the MOS (Metal Oxide Semiconductor) technology. This series of successful new product developments and launches was enabled by Noyce, Hoff and the former Fairchild MOS expert Federico Faggin. Faggin left Intel in 1974 and founded Zilog to compete with Intel. Intel's entrepreneurial process also laid down the foundation not only for itself to claim the leadership position in the chip industry, but also for Silicon Valley to lead the semiconductor industry globally. The legacies left by Fairchild and Intel started Silicon Valley as we know it today. Fairchild's and Intel's entrepreneurial processes as well as their interaction with the ecosystem are mapped out in Figure 4-3, with major events highlighted.

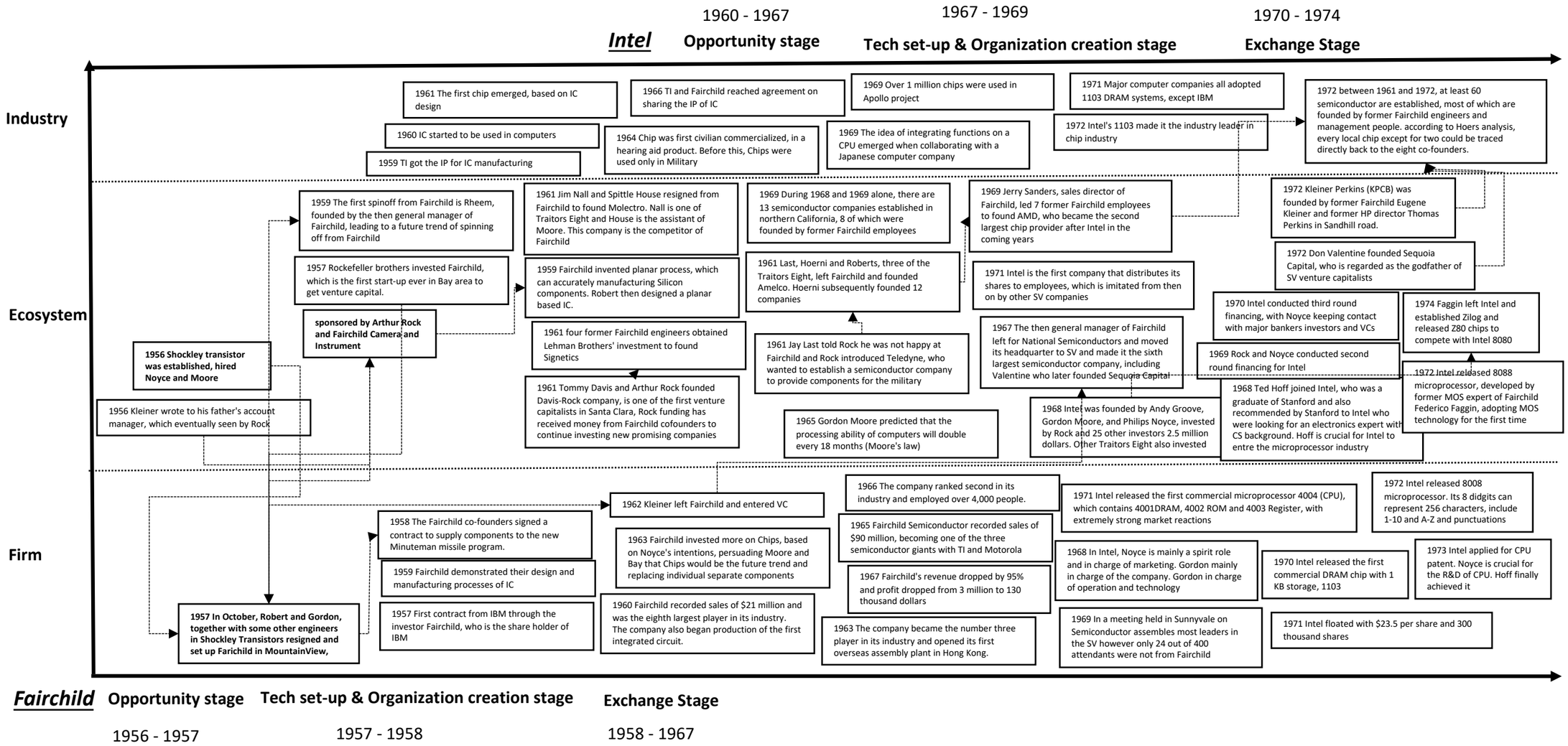


Figure 4–3 Fairchild-Intel's entrepreneurial processes and their interactions with the Silicon Valley entrepreneurial ecosystem

4.2.3 Apple's entrepreneurial process (1974-1986) and interaction with the EE

Apple's two co-founders, Wozniak and Jobs, got to know each other in 1969 in their high school. They were both enthusiastic about electronics and computers. Wozniak's father was an engineer in Lockheed Martin in the Bay Area, and he taught Wozniak a great deal about electronics. The young Wozniak even got an internship in Silvania and worked with a computer. Steve Jobs was also excellent with computers. In 1969, he quit university but kept on attending computer science classes. A few years later, Jobs started to work for Atari, one of the first computer game companies. His experiences of working at Atari with its founder, Nolan Bushnell, helped Jobs understand product design in his early career. He also got to know Ronald Wayne at Atari, who had been very briefly involved with Apple at the beginning. In the meantime, Jobs attended a few computer science courses at Stanford University and started a joint project on personal computers, Apple I, with Wozniak.

It was perfect timing. In the 1970s, people were starting to realise the power of computers for individuals, differing to the previous notion that computers should only belong to governments and research institutes. In 1975, French Gordon and Fred Moore founded a computer fan club called the Homebrew Computer Club was founded in order to create a platform for computer lovers to communicate and share ideas. The club is famous for its members sharing ideas and helping each other in all aspects of computing, which represented the open culture of Silicon Valley. Wozniak was a member of the club and, at the club's first meeting, which discussed Altair, a microcomputer developed by a company in New Mexico, he was inspired to design a microcomputer. This was the start of their first project, Apple I. Initially, Wozniak wanted to use Intel 8080, but it turned out to be too expensive for them. He instead used Motorola 6800 since a friend of his who was working in HP could get him the chip for only $40. Meanwhile Jobs managed to get DRAMs from Intel and asked an Atari employee to design the main board. Wozniak demonstrated their first Apple I sample at the Homebrew Club, and received a great deal of useful feedback that benefitted future versions.

At first Wozniak was thinking of selling this design to HP, where he was working. However, it turned out that HP was not interested. When Jobs asked him, Wozniak agreed to use this design exclusively in Apple computers. In 1976, Jobs and Wozniak performed another demonstration at the Homebrew Club and drew the attention of a local computer shop called Byteshop, established by Paul Terrell. Terrell made Apple's first order – 50 Apple I computers.

The Homebrew Club did not only bring ideas, but also helpers and competitors. As Jobs started to design Apple II, he hired Jerry Manock, whom he had met at the club, to design the body of the computer. Meanwhile, microcomputer SOL-20 from the Processor Technology Corporation, founded by Lee Felsenstein and Gordon French, who were also members of the club, was the earliest of Apple's competitors. As Apple II's development went on, Jobs' prior network helped him get more people on board. For example, Atari's director, Bushnell, introduced Rod Holt, a former Atari computer engineer, to Jobs; Holt then joined Apple to design the power supply. Apple II had a revolutionary design: it was the first whole-body computer, containing everything the customer would need inside one single box.

In 1976, Apple was formally founded. Like any other start-up, Apple needed funding to support its new product developments. Bushnell suggested Jobs approach Don Valentine, the founder of Sequoia Capital, who agreed to invest and also introduced his former colleague, Mike Markkula, to Apple. Markkula, who was a former Intel sales director and had retired from the company at the age of just 34, joined Apple in 1976. He also invested and held 26% shares in the company. In 1977, Apple II was released and Markkula persuaded Rock to invest in Apple. After seeing a successful demonstration of Apple II at the West Coast Computer Fair, Rock was impressed and agreed to invest in Apple. Markkula also invited his former colleague at Fairchild, Mike Scott, to be the CEO of Apple. As Markkula had a controlling interest in the company, Jobs and Wozniak had little say in the matter, and it was in fact one of the reasons why Jobs later left Apple. In 1977, Apple was restructured following the addition of several new senior executives and the release of Apple II.

Perhaps Apple's most significant contribution to the personal computer sector was the

Macintosh. It all began in 1978, when Apple's new employee, Bill Atkinson, and his mentor, Jef Raskin, introduced Jobs to the Xerox Silicon Valley research centre. As Xerox was involved in the second-round financing of Apple, they agreed to show Jobs what was going on at the research centre. In the meantime, Jobs was working on a new project, the LISA computer, and Raskin was leading the Macintosh project. They hired many engineers from HP and were both developing the next generation of personal computers. In a demonstration in Xerox Silicon Valley, Jobs was inspired by Xerox's idea to adopt the Graphical User Interface (GUI) and mouse in the new Apple computers, which was significantly different from the command-line style of traditional computers. Although in 1981, Xerox released XeroxStar earlier than the Macintosh, the product was quite expensive and not user-friendly, and eventually proved unsuccessful. Jobs persuaded the then XeroxStar hardware manager Bob Belleville to join Apple and develop the Macintosh. Jobs took over the Macintosh project from Raskin and put the concepts of GUI and mouse into this new generation of computers. In 1984, the Macintosh was released and its advertisements at the Super Bowl helped it gain huge success. Jobs subsequently built up a factory to produce the Macintosh in Fremont. Apple became the most topical company worldwide. Its IPO was the largest since Ford's in 1956.

However, the conflicts in Apple were aggregating. As the sales of Apple III and LISA were cannibalised by the Macintosh, Jobs' arbitrary actions on taking over Macintosh and lack of cooperation and communication with other projects had made senior executives and shareholders furious. When Markkula hired the former sales director of Pepsi, John Sculley, as the new CEO of Apple, Jobs was made a figurehead. He could not tolerate this and resigned after a conflict with Sculley over the Macintosh's decline in sales in 1985. Jobs immediately sold all his shares in Apple and started NeXT, an animation company, with some loyal former Apple employees. Nevertheless, based on the success of its first 10 years, Apple managed to keep growing. Twenty years later, as Jobs returned and rejuvenated Apple with the iPod and iPhone, Apple became the most valuable company globally.

Apple's entrepreneurial process and interaction with ecosystem are mapped out in Figure 4-4, with major events highlighted.

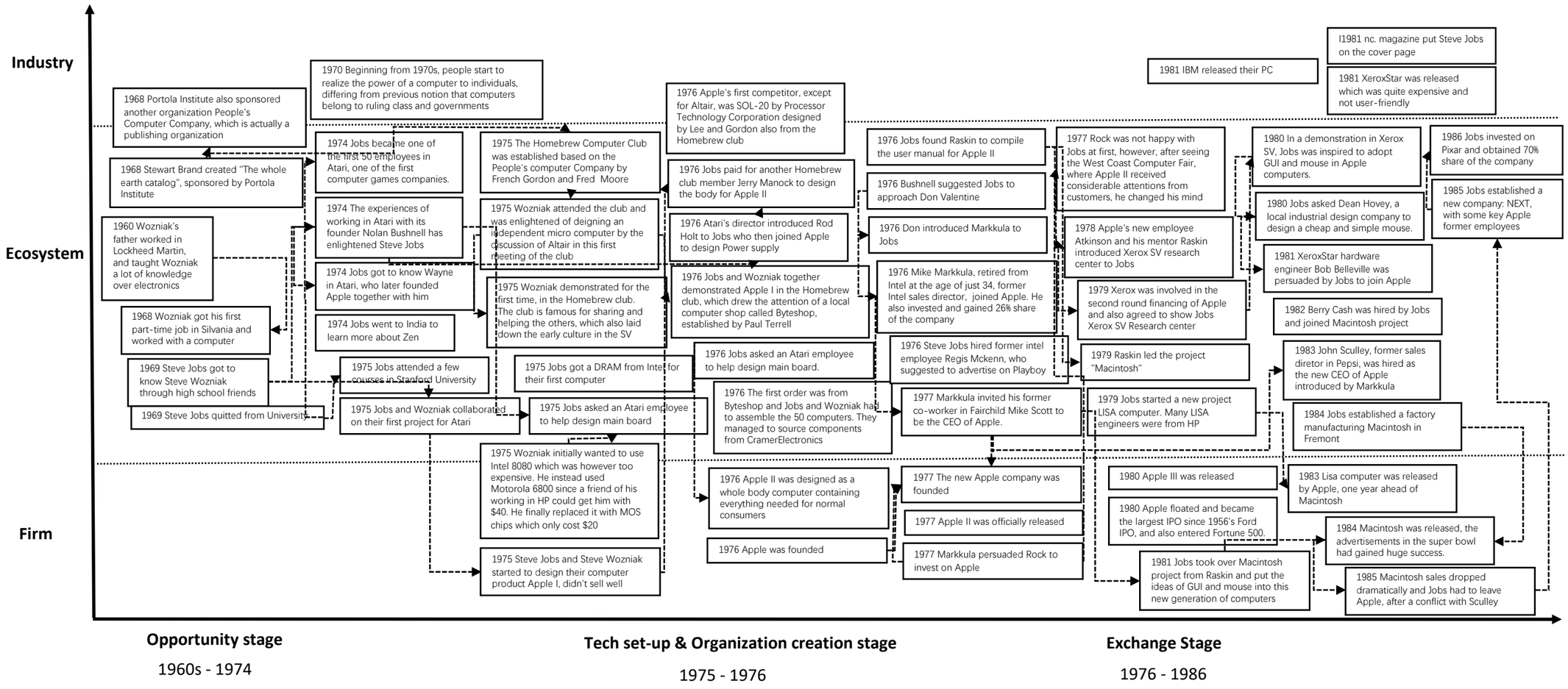


Figure 4–4 Apple's entrepreneurial process and its interactions with the Silicon Valley entrepreneurial ecosystem

4.2.4 Google's entrepreneurial process (1994-2004) and interaction with the EE

Google is the world's largest search engine company. It also owns the most popular smartphone operating system, Android. Listed as one of the most valuable companies globally, Google's entrepreneurial process dates back to the 1990s, as mapped out in Figure 4-5. At that time, the Internet was filled with open source spirit: Internet pioneers such as hackers, online game players, software pirates and independent programmers wanted to share their creations with the world. However, to find the information required was difficult – imagine yourself surfing the Internet without any search engines – although the Internet industry changed dramatically in 1994 when Netscape introduced a graphical user interface for web browsers and Yahoo! was established as a portal to access other websites. There were even search solutions before Google – but the first type of search engines only returned websites and storage, not connections between them. This was where Google came in and completely inverted the whole industry.

One of Google's co-founders, Sergey Brin, entered the PhD programme at Stanford University in 1994, and met Larry Page in the summer of 1995; Page had joined Stanford as a new PhD student in the computer science department. Page first conceived the idea of identifying the links between webpages and told his supervisor, Hector Garcia-Molina, about ranking different webpages based on their connections with each other. Garcia-Molina encouraged him to undertake the project, named BackRub, and it became the origin of PageRank, the core of Google. In 1995, Page started the project. Interestingly, Brin started a complementary project on crawlers to the PageRank. When Brin and Page found out about each other's project, they decided to merge them and work together to develop algorithms for evaluating the important links. Such a project needs huge computing capacity. Brin and Page borrowed idle computers and CPUs from various departments to run their program. Garcia-Molina also managed to get them funding from the Digital Libraries project for them to purchase more computers. The Google program consumed nearly half of the total network bandwidth, although Stanford was the best networked institution in the world. Fortunately, and the university allowed them to

continue their project. In 1996, the first version of Google was released.

Initially, Brin and Page were not willing to commercialise Google because to do so went against their original intention, which was for the search engine to be free to everyone. This caused conflicts in the founding team. Brian Lent, a Stanford graduate, one of the starting members in the Google project, insisted on commercialising it but eventually left the team and became the CEO for Medio Systems Inc. When the duo finally made up their mind to profit from Google, they were only willing to sell it to the established companies. However, their offer was turned down by multiple companies. In the meantime, Brin's advisor at Stanford encouraged him to start Google as a company and discontinue his PhD. Eventually, he and Page took the advice.

In 1998, Google formally released its search engine with PageRank as its core system. Meanwhile, Brin and Page needed to look for investors. Google's earliest investment of $0.1 million was from a Silicon Valley entrepreneur, Andy Bechtolsheim, introduced to them by David Cheriton, a computer science professor at Stanford, who had started a couple of companies with Bechtolsheim. As a return for the project, Stanford held part of PageRank's patent, which in exchange made a profit of $336 million later. In 1999, Brin and Page managed to get further investment from John Doerr at KPCB and Mike Moritz at Sequoia, $12.5 million from each with a 9% share, which was incredibly low for both companies considering their bargaining power in the industry. Since its earliest years, Google has kept attracting young computer science talents with employee perks: free food and drinks, massages, etc., and the culture of doing something incredible. In its first three years, Google's new employees were almost all from Stanford's computer science department. Their talent strategy was smart – hiring only young people who could work long hours and accept the Google culture.

As Google expanded and grew larger, Brin and Page felt that they needed a CEO to handle daily operations and also prepare for IPO. In a Personal Computer Industry Forum held in Silicon Valley, Page met Eric Schmidt, who was the CEO of Novell at that time. They had a good conversation and Page thought he would be a good choice for CEO. After the forum, Schmidt ran into John Doerr, co-founder of KPCB and investor in Google. Doerr informed

Schmidt that he was shortlisted to take over the CEO position at Google and persuaded him to accept the offer. In 2001, KPCB connected Google with AOL, which was invested in by KPCB as well. AOL had the intention to diversify its online advertisement businesses and Google also intended to profit from advertising. The two companies quickly reached an agreement for AOL to license Google's search engine and put it on the AOL website to display advertisements dynamically, which generated huge profits for AOL. Meanwhile, Google was also developing its own advertising systems. When Schmidt became the CEO, he persuaded Hal Varian, who was the founding dean of UC Berkeley's School of Information, to join Google as the Chief Economist and help to design Google's auction-based advertising program. In 2002, Google officially released this new system to replace the traditional fixed-fee advertisements. It would also place advertisements on other websites depending on the users' search history, rather than relying entirely on advertisements that only showed up in the search results when using Google. With this new advertisement system, Google's profit escalated past $100 million in 2003.

To this end, Brin and Page began to consider IPO. Being overly idiosyncratic, they did not want to follow the traditional IPO approach established by Wall Street. The traditional IPO approach was to prioritise the demand of major clients of big investment banks. Prior to the IPO of a prospective start-up, the investment banks will normally inform these major clients and offer them the opportunity to buy shares at a lower price beforehand. This means when the shares are being distributed on the day of IPO, most individual investors would not have the access to buy any shares. This was not Brin and Page wanted. Instead, they wanted all investors to have an equal right to buy shares in Google. There was indeed an investment bank that was willing to fulfil their wish. Bill Hambrecht, a former employee from H&Q, an investment bank in San Francisco established in 1968, started WR Hambrecht and Co., with the promise of setting IPO prices at the price the public was actually willing to pay and able to buy on the day. Larry and Sergey decided to go the unconventional way of IPO – taking control from large institutions and investors on Wall Street and being 'fair' to all investors. In 2004, Google floated. Although Google's IPO was not as successful as Brin and Page had imagined, as the leading investment banks were reluctant to play Google's way and deterred institutional investors, they still managed to pave a new way for IPO that influenced future IPOs of start-ups in Silicon Valley.

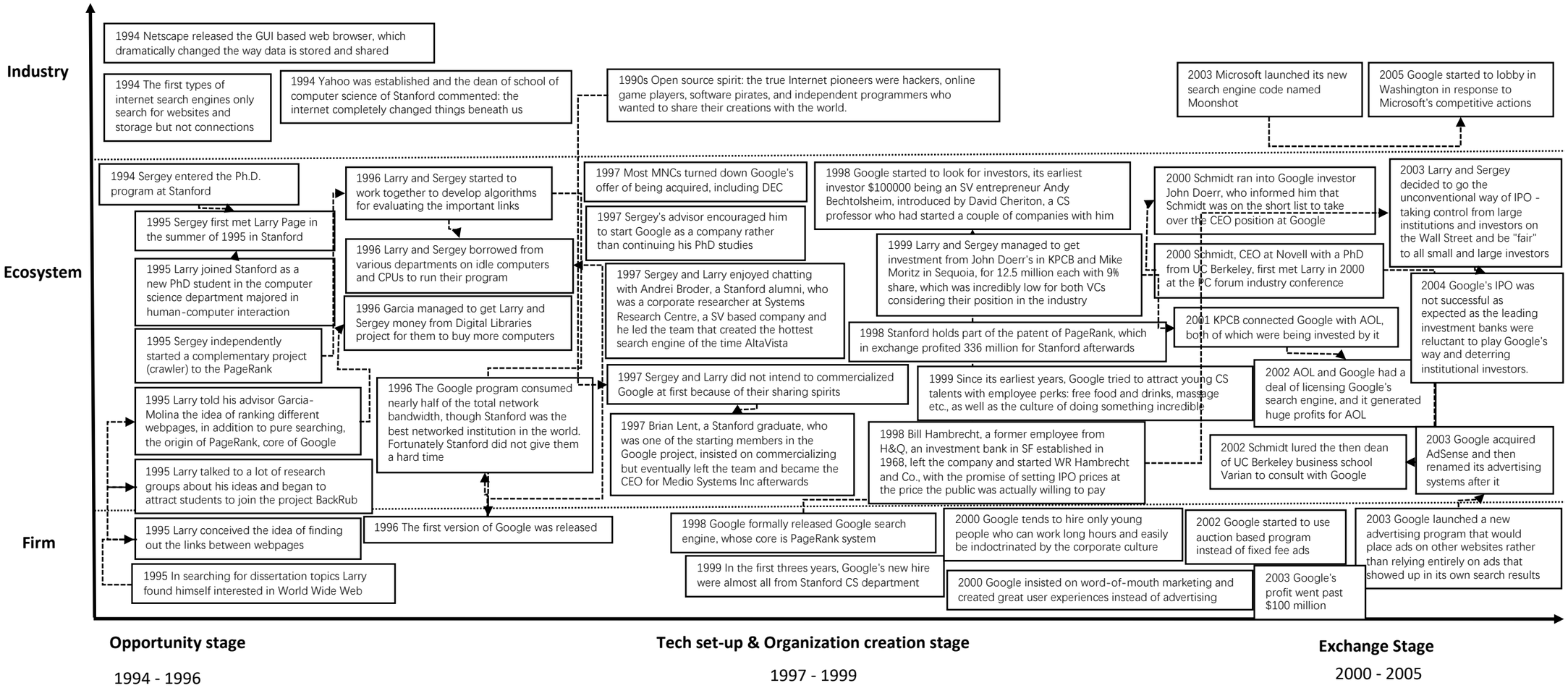


Figure 4–5 Google's entrepreneurial process and its interactions with the Silicon Valley entrepreneurial ecosystem

4.2.5 Tesla's entrepreneurial process (2003-2010) and interaction with the EE

Tesla is a world-leading company specialising in electric vehicles, energy storage and solar panel production; it is based in Palo Alto, California. Tesla's electric vehicles have led the trend globally to gradually replace fossil fuel vehicles. The founder of Tesla, Elon Musk, has a long history of new venture creation in Silicon Valley.

Musk went to Silicon Valley in 1994 to work as an intern for an energy start-up, Pinnacle, and a game company, Rocket Science Game. When he finally decided to stay in Silicon Valley in 1995, he also persuaded his brother to come along. Initially, Musk wanted to pursue a PhD in material sciences at Stanford University. However, after two days at the university, he changed his mind and was determined to establish an Internet company instead. In 1995, Musk and his brother set up Zip 2 in Palo Alto, a website combining the features of what are now Yelp and Google Maps. In the beginning, Musk experienced a tough time – he had to borrow $28,000 from his father. Later, Jim Ambras, who worked at HP and Silicon Graphics Inc., joined Zip 2 as vice president of engineering. He also brought a few other Silicon Graphics engineers. In 1997, Zip 2 achieved great success in the newspaper industry and acquired its main competitor, City Search. In 1999, when Compaq acquired Zip 2, Musk left the company.

It was time for Musk to establish a new company. As early as 1995, Musk had conceived the idea of Internet banking, believing that Internet finance would soon emerge and disrupt traditional banking. With the $1.2 million he had obtained during Zip 2's acquisition, he established X.com to fulfil his Internet banking idea. In the beginning, Musk created a star team for X.com, consisting of previous Silicon Graphics and Zip2 engineers. In 1999, Sequoia's Mike Moritz decided to invest in Musk and X.com. Later, X.com established the first online banking system in collaboration with Barclays and the Federal Deposit Insurance Corporation. The opportunity was sensed by others as well: in 1999, Confinity was established in Silicon Valley, by Peter Thiel and Max Levchin, as a direct competitor to X.com. In 2000, Confinity merged with X.com and was renamed PayPal, with Thiel being the CEO. Musk left

the company following the acquisition of PayPal by eBay in 2002 for $1.5 billion.

Surprisingly, Musk founded SpaceX with all the money he had obtained from the eBay acquisition and set a goal for SpaceX to colonise Mars. However, he was ambitious enough to get involved in another seemingly impossible project. In the early 2000s, Jeffery Brian Straubel, a Silicon Valley entrepreneur who was passionate about electric vehicles, started to sell his idea of creating a solar energy car. Musk was very interested in this idea and immediately invested $100,000. As a result, Musk and Straubel visited AC Propulsion, a company producing the earliest electric vehicles in Los Angeles. Although they were not satisfied with AC Propulsion's products, they learnt that the company had been invested in by Martin Eberhard and Marc Tarpenning. These two entrepreneurs had started to develop electric cars after their first start-up NuvoMedia was acquired in Silicon Valley. In 2003, Eberhard and Tarpenning founded Tesla in Menlo Park and started to look for investors. Coincidentally, Eberhard and Tarpenning were told by AC Propulsion's executives that Musk was looking for electric vehicle projects and they remembered attending Musk's talk in 2001 where he expressed his interest in replacing fossil fuel vehicles with electric vehicles. They immediately decided to approach Musk, and Musk agreed to invest $6.5 million, making him Tesla's biggest shareholder.

Subsequently, Straubel was hired by Tesla at Musk's request. As a Stanford graduate, Straubel recruited a few other Stanford engineers to Tesla. In 2004, Tesla established a factory in San Carlos to develop the Roadster. Initially, Tesla engineers only focused on the battery system and outsourced all other components to Europe and Asia. In 2005, the first Roadster model was developed and went on trial. Musk was excited and invested a further $9 million. However, as the capacity grew, Tesla found itself dealing with hardware issues such as battery safety. In 2006, Tesla grew to 100 engineers and produced a black Roaster prototype, which was demonstrated in Santa Clara and was the subject of numerous reports in the media. As a result, many car show organisers invited Tesla to their shows for free. This helped Tesla to raise $40 million afterwards, including famous VCs and investors in Silicon Valley such as Draper Fisher Jurveston, VantagePoint Capital Partners and Larry Page. The improvement in computational power in the 2000s granted small car manufacturers advantages compared to traditional car

giants, for example, the crash tests can now be implemented in the computer instead of physical tests – computer simulation saves small manufacturers a great deal of R&D investment.

In 2007, the Tesla team grew to 200 engineers and completed a mission impossible – produce the most beautiful and elegant electrical car from scratch in only two years' time. However, Tesla still faced with supplier issues when launching its products on the market. To lower costs, Tesla set up a battery factory in Thailand, and procured panels from France, electrical engines from Taiwan and single batteries from China. In addition, like what Google did in its early days, Tesla only hired fresh Stanford graduates rather than experienced engineers, to cut down operation costs. The second half of 2007 was not smooth for Tesla, as a few key employees left the company and the Roadster project was not going well. Eberhard was demoted from CEO to CTO, and finally left Tesla at the end of 2007. Former Flextronics CEO Michael Marks assumed the CEO position and wanted to sell Tesla when it was still worth the market value, which Musk was not interested in doing at all. Very soon, Zeev Drori, the founder of a DRAM company in the Valley, replaced Marks as the new CEO.

To support the development of a new car, the Model S, Musk kept investing in Tesla. By 2008, he had invested more than $140 million in Tesla's R&D and it was challenging to seek more investments during the financial crisis. Musk soon ran out of money and had to turn to his friends in Silicon Valley for additional help. In the meantime, he also sold his shares in SolarCity and Everdream to raise $20 million. The toughest time ended when Space X successfully launched its rockets and NASA agreed to place a $1.6 billion order, and they even agreed that Musk could use some of the money in Tesla temporarily. In 2009, Musk announced the official release of Model S, which ignited the market. The US government decided to provide a $465 million loan to Tesla to support its further product development. With these investments, Tesla acquired the assembly factory set up by General Motor and Toyota in Fremont, California, and entered mass production of Model S, following huge numbers of pre-orders from all over the world. In 2010, Tesla's IPO successfully raised $226 million. Tesla's entrepreneurial process and interaction with the ecosystem are mapped out in Figure 4-6, with major events highlighted.

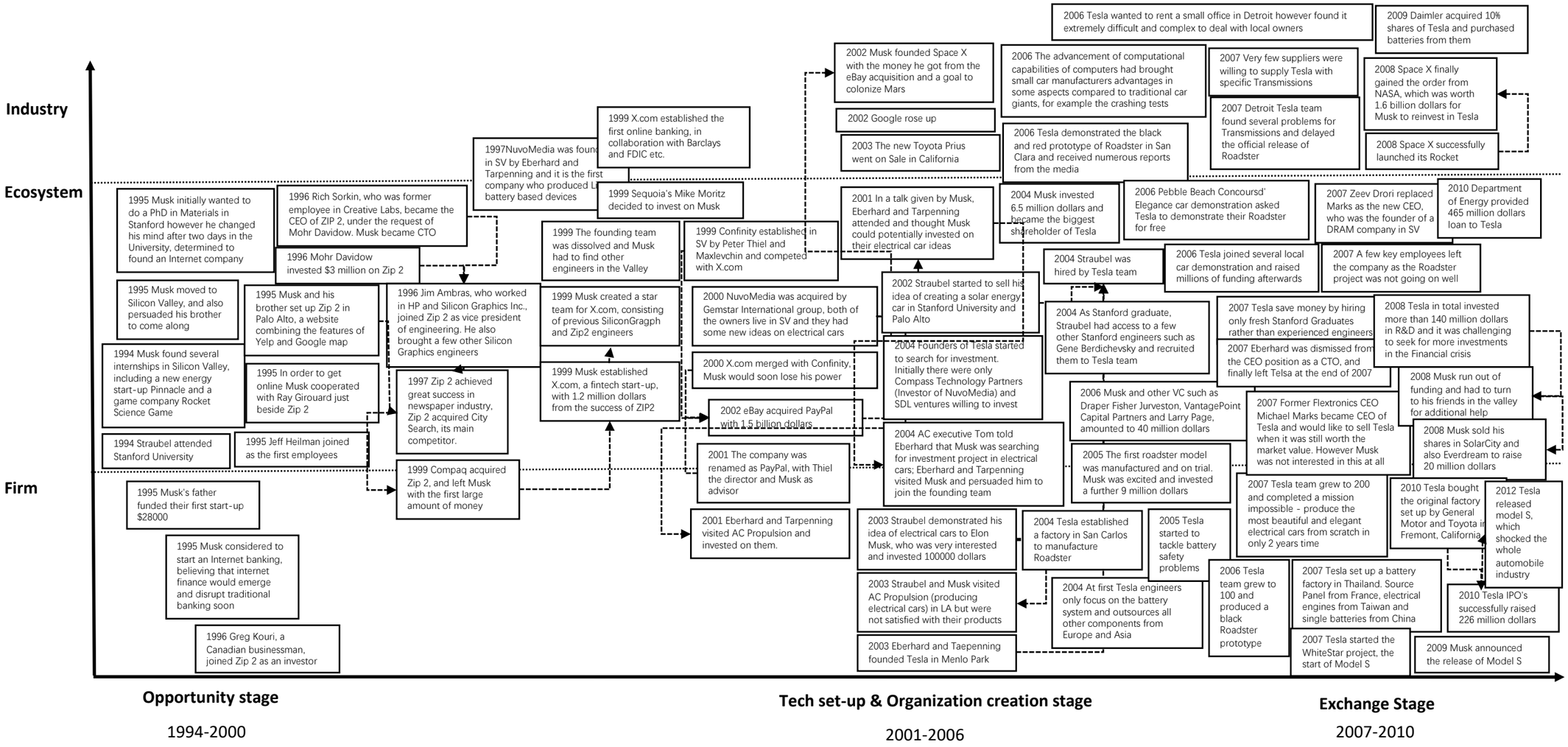


Figure 4–6 Tesla's entrepreneurial process and its interactions with the Silicon Valley entrepreneurial ecosystem

4.3 Shenzhen entrepreneurial ecosystem

This section starts with an overview of Shenzhen entrepreneurial ecosystem's development, providing historical and current accounts. Then the entrepreneurial processes of key companies in different stages of Shenzhen entrepreneurial ecosystem's evolution are demonstrated.

4.3.1 Shenzhen EE overview: historical and current accounts

Shenzhen, seated in the Pearl River Delta (PRD) region of the southern China and right next to Hong Kong, is among the most prosperous cities in China, coming right after Beijing, Shanghai and Guangzhou. Specialising in the ICT industry, Shenzhen has developed superior manufacturing capabilities over its years of contracted manufacturing and recently enhanced its innovation capabilities through industrial upgrading and transformation. It is the home of a handful of the most famous Chinese brands such as Huawei, Tencent and DJI.

Shenzhen entrepreneurial ecosystem's evolution is divided into four stages, as is illustrated in Figure 4-7: the genesis of Shenzhen when it opened up to the world as a special economic zone and provided the most basic manufacturing services for foreign companies; the emerging phase, marked by the accumulation of manufacturing infrastructure through contract manufacturing of electronics and the emergence of telecommunications equipment from the end of 1980s until the late-1990s; the growing phase, with the emergence of various specialised players for new venture creation and further accumulation of key resources evident through the Shanzhai copycats and the rise of the Internet industry from the late 1990s to 2000s; and the mature phase, marked by a highly modularised venture creation process, with numerous organisations in each of the new venture creation activities; as well as a dominant digital hardware industry evident through the sustained creation of high-quality new ventures in this domain since the 2010s.

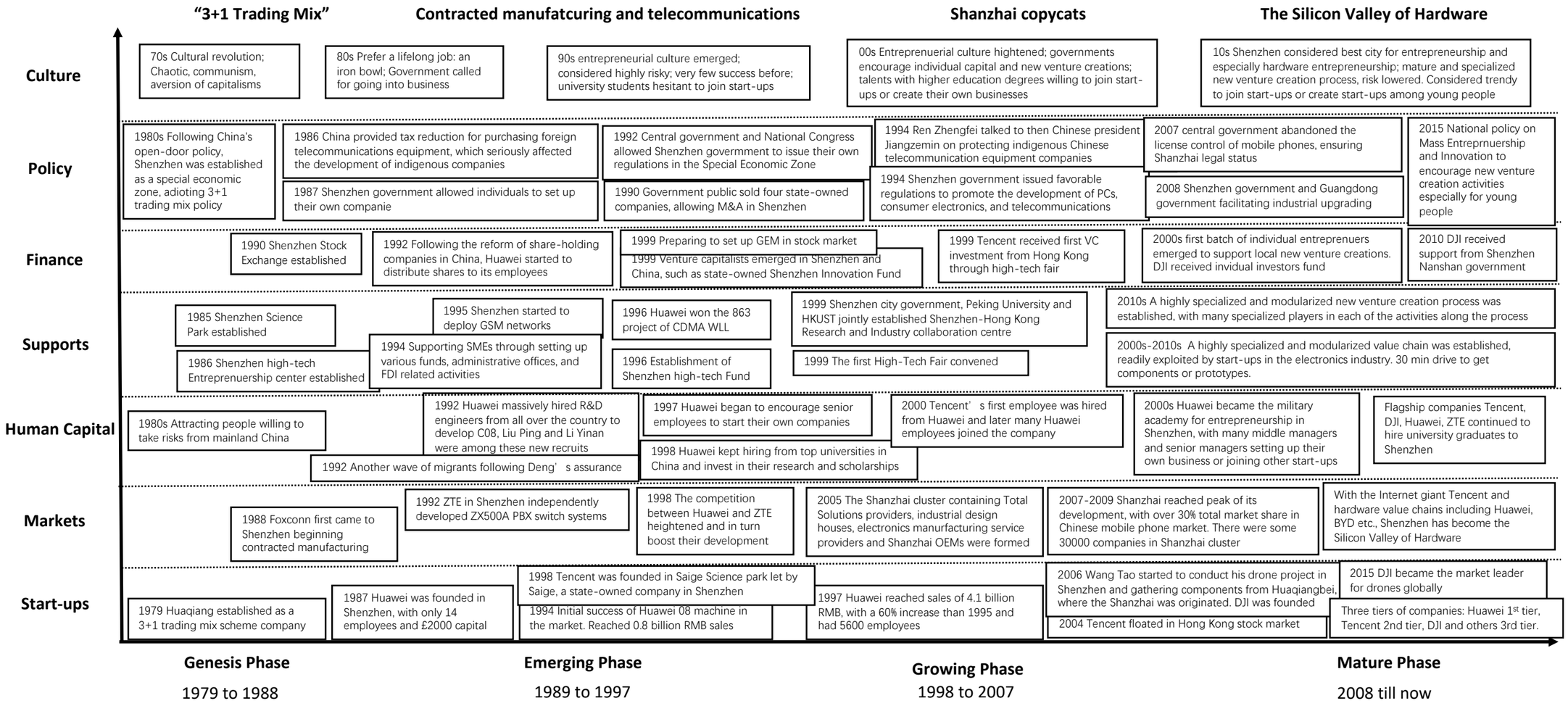


Figure 4–7 The evolution of the Shenzhen entrepreneurial ecosystem

The inheritance of new venture creation in different stages of Shenzhen's development is prominent, from Huawei in Shenzhen ecosystem's emerging phase, to Tencent in the growing phase, and then to DJI in its mature phase, as noted by a senior consultant at Huawei:

> *Shenzhen is definitely the best city for entrepreneurship in China because of its clearly tiered ecosystem divided by different phases of development in Shenzhen – the first tier is Huawei, second tier is Tencent, and third tier is companies like DJI and over 500 promising start-ups with sales between 2 billion and 10 billion RMB…*

Genesis: '3+1 Trading Mix' in Shenzhen special economic zone (1979-1988)

Shenzhen is a very young city. As a small village historically, it has been built up from nearly nothing since 1979, when China decided to open herself up to the world again and the central government set up a few Special Economic Zones, including Shenzhen, to experiment with a market economy. It was a tough starting point. After 10 years of chaos brought by the Cultural Revolution, Shenzhen and even the whole of China did not have much to offer for the international markets. Yet, despite the chaos and the poverty and other depredations it brought, the country established a comprehensive educational system. Thus, even before the introduction of the open-door policy, Chinese workers were comparably better educated than those in other poor countries. This and the fact that they were willing to accept low wages, coupled with the vast market, attracted companies from richer, developed economies.

In such circumstances, the Chinese government adopted the '3+1 Trading Mix' policy. The model was simple yet highly attractive: Shenzhen would provide heavily discounted land and a cheap labour force whereas foreign companies would provide raw materials, prototypes/designs and required components for these Shenzhen (state-owned) companies to manufacture and assemble. Note that this is different from contracted manufacturing, as the former would not engage in anything outside of pure assembly and processing – they did not need to purchase any materials or test-run any prototypes, and they did not even have to purchase their own machines, all of which were supplied by foreign investments should they

participate in the scheme. Therefore, the '3+1 Trading Mix' involved only the most basic assembling tasks and was purely taking advantage of the cheap labour and easily accessible land, in order to gain a start for Shenzhen. Along with the '3+1 Trading Mix' initiatives, Shenzhen's government also released stimulating policies to encourage further foreign investments and domestic spending, such as discounted import tax for industrial equipment, and designated labour wages than were higher than inland China but significantly lower than Hong Kong, along with other benefits including reduced administrative fees and procedures.

Starting from the Shekou industrial zone in eastern Shenzhen at the beginning of 1980s, the primary focus of Shenzhen was on light manufacturing such as food processing, beverage and textiles, etc., many of which were actually transferred over from Hong Kong. Although in a modest position, Shenzhen's electronics industry began with the establishment of Huaqiang in 1979, a state-owned company that initially focused on manufacturing radios and tape recorders. By participating in the '3+1' scheme in cooperation with Sanyo, Huaqiang gained initial capability in electronics manufacturing. Sanyo's investments further enabled a joint venture between the two companies in 1984, which set out to independently produce radios and tape recorders, granting Huaqiang further capabilities in product design and development. Huaqiang is among the numerous examples of Shenzhen's fast-growing electronics industry. It is estimated that, between 1979 and 1985, the '3+1 Trading Mix' accounted for 76% of the total projects led by foreign direct investment (FDI) in Shenzhen, and the Shenzhen electronics industry grew from nothing to over 170 companies producing televisions, radios, tape recorders and telephones, etc., as well as the associated manufacturing technologies and infrastructure. The electronics industry accounted for more than 40% of the total industrial output in Shenzhen by the end of 1985. When SEG group, combining 117 state-owned companies across multiple sectors, and Shenzhen Industry Association for Electronics were both established in 1986 to further integrate the manufacturing capabilities that accumulated in the '3+1 Trading Mix' period, Shenzhen began to shift to contracted manufacturing.

Meanwhile, entrepreneurial activities and organisations emerged in Shenzhen, primarily led by governments at this stage. In 1985, the Shenzhen government and Chinese Academy of Science

jointly established Shenzhen's first science park, Shenzhen Science Park, and first incubator, Shenzhen High-tech Entrepreneurship Centre. While previous venture creation activities were all initiated by the central and local governments, in 1987 the Shenzhen government issued a new regulation to allow technology start-ups by individuals with their private capital. After that, new venture activities by individuals started to take off: Huawei, which later became an ICT industry giant across multiple sectors, was founded in the same year.

This period was experimental and disruptive for the whole society, as almost all institutional and non-institutional arrangements pertinent to laws and regulations as well as cultural beliefs and mind-sets had to be adjusted to fit with the new market economy. It was also marked by the first wave of immigrants from all over China, many of whom came with entrepreneurial mind-sets, hoping to make a fortune or at least improve their lives. It laid down the foundation for Shenzhen's transition to ICT industry and movement up the value chains afterwards. By the end of 1988, as the traditional '3+1 Trading Mix' companies began to relocate to other cities in Guangdong and inland China, Shenzhen's ecosystem was ready to migrate to the next phase of development.

Emerging: contracted manufacturing and telecommunications industry (1989-1997)

As Foxconn set foot in Shenzhen for the first time at the end of 1988, Shenzhen's ecosystem entered its emerging phase, which is marked by massive contracted manufacturing activities and the rise of the telecommunications industry. The SEG group, which was previously involved in the '3+1 Trading Mix', started to engage in contracted manufacturing at the end of the 1980s. In 1991, SEG's joint venture with Hitachi to produce colour picture tubes for the latter began operation. Foxconn, since its entry into China, quickly leveraged the local skilled yet cheap labour force and grew its business in contract manufacturing for consumer electronics.

Telecommunications equipment also emerged in Shenzhen, as Huawei and ZTE gradually caught up with their overseas competitors. In 1989, when Huawei and ZTE both set out to independently develop their switching systems, there were some 200 small indigenous

manufacturers in Shenzhen which could only provide low-end products. By 1992, both ZTE and Huawei had considerable R&D teams by heavily hiring from universities in inland China. In the mid-1990s, Huawei and ZTE successfully developed their own products, and started to capture the market with competitive prices and superior services. The Chinese local and central governments supported them – for example, Huawei won the contract for Shenzhen GSM network deployment, and the central government issued favourable regulations to protect indigenous telecommunications equipment companies. The competition between ZTE and Huawei heightened from the mid-1990s and the two companies in turn boosted each other's development. The impacts from the emergence of the telecommunications equipment sector were immense for Shenzhen, as companies in this sector such as Huawei and ZTE did not only attract talents from outside of Shenzhen, but also equipped these talents with knowledge and skills in the general electronics industry, as well as providing financial resources for those who joined Huawei in its early days and cashed out their share options. These people enriched Shenzhen's talent pool after they left the companies and became individual investors for local start-ups or middle to senior managers in other companies in Shenzhen.

In the meantime, the institutional environment in China was unprecedentedly loose, in terms of regulations, privatisation and corporate finance, in the early 1990s. In 1990, Shenzhen's government publicly sold four state-owned enterprises, which enabled private capital to be invested into acquiring state-owned companies for the first time. Following this, mergers & acquisitions became prevalent in Shenzhen, which created a friendly environment for start-ups. In the same year, the Shenzhen stock exchange started its trial and was formally established one year later. In 1992, China's then leader, Deng Xiaoping, visited Shenzhen again and reassured foreign companies that the Chinese government was determined to continue with the country's economic reform. Following his assertion, foreign investments reached a historical high – some 5000 foreign companies were established in Shenzhen by the end of 1992. In the meantime, another migrant wave from inland China to Shenzhen started, contributing further to Shenzhen's talent pool. Deng's endorsements also helped Shenzhen obtain a special legislative power locally, which was almost immediately used after its approval in the Chinese National Congress in 1992. Indeed, six months later, Shenzhen's government issued a series of

new regulations regarding the transformation of state-owned companies to shareholding companies, encouraging technology holders regardless of their nationality to acquire shares in exchange for their technologies. Another new regulation in 1994 pertinent to shareholding companies enabled Huawei to distribute its shares to raise R&D funding and also later as benefits for employees for the first time, which was imitated by other companies in Shenzhen to encourage young people, such as government and state-owned companies' employees, to join start-ups rather than holding 'iron rice bowl' jobs, which were traditionally perceived as better, more secure jobs in China.

In 1994, Shenzhen's government decided to focus on supporting the development of personal computers and related software, telecommunications and electronic components, as well as new materials, etc. On the one hand, Shenzhen's government actively supported private companies in the region to raise funding through the Shenzhen stock exchange and also financially supported private small-medium enterprises (SMEs) such as Huawei for their product development. Shenzhen's first venture capital firm – Shenzhen High-Tech Fund – was established by the Shenzhen government in the same year, in order to provide investments and loans for the earliest start-ups in Shenzhen. On the other hand, the Shenzhen government shifted from the '3+1 Trading Mix' to encouraging foreign direct investments, attracting international incumbents – such as IBM, Flextronics, Samsung, HP and Philips, etc. – to set up their advanced manufacturing in Shenzhen, which brought new technologies and tacit knowledge. By the end of 1996, Shenzhen housed more than 2300 electronics companies and the industrial output accounted for over 50% of the total productivity in the region.

This phase is marked with the emergence and accumulation of a manufacturing base and infrastructure in Shenzhen's ecosystem. However, there were also failed attempts to upgrade consumer electronics further, from the production of tape recorders and radios to mobile phones and personal computers, in the mid-1990s in Shenzhen by a Guangdong provincial company due to the untapped market and unestablished value chains in the region. The intention was advanced, but the timing was not quite right, until the next phase of Shenzhen's development: Shanzhai mobile phones and the rise of the Internet.

Growing: Shanzhai copycats (1998-2007)

The end of the 1990s witnessed the take-off of entrepreneurship in Shenzhen. This stage was activated by Shenzhen's government and the central government, but was further propelled by the Shanzhai copycats, establishing a comprehensive value chain for electronics.

The tipping point was the year 1999. Realising the growing demand of SMEs in financing, the Chinese central government decided to set up a Growth Enterprise Market (GEM) in the Shenzhen stock exchange, which was formally opened in 2004, after a five-year transitional and preparatory period. One of the most notable preparatory initiatives for the set-up of the GEM in the Shenzhen stock market was to establish venture capitalists in Shenzhen and also allow private capital into the venture capitalist industry, which essentially facilitated the emergence of a venture capitalist industry in Shenzhen and even in China, as a senior manager in a leading venture capital firm noted,

> *1999 can be regarded as Year One for venture capitalists in China. The national government and Shenzhen government decided to establish a Growth Enterprise Market in the Shenzhen stock market and therefore open up the capital market to both state-owned and private companies to fund start-ups…*

Notable state-owned venture capitalists including the Shenzhen Innovation Fund and Shenzhen High-Tech Fund were established or expanded subsequently to support new venture creation activities in Shenzhen. Many private venture capitalists emerged at the same time and gradually developed into leading funds, such as Green Pine Capital Partners. More importantly, individual investors who used to be senior industry practitioners (e.g. engineers from Huawei) emerged, as the financial regulations were relaxed, further boosting the entrepreneurial activities in Shenzhen. Under this context, the first National High-Tech Fair was jointly held in Shenzhen by the central government, Shenzhen government and Chinese Academy of Science; it was the country's first large-scale event for start-ups with leading technologies in China to demonstrate their products and solutions, together with upstream and downstream suppliers and manufacturers, as well as investors and industry delegates from other parts of

China. Many Shenzhen companies received venture investment for the first time, a novel form of investment for many of their founders. For example, Tencent, which entered the market in 1998 with its first instant messaging software imitating ICQ and designed for Chinese users' habits in SEG group's science park, secured their first venture capital investments from a Hong Kong investment fund through attending the High-Tech Fair. This investment helped Tencent survive the toughest time in its entrepreneurial journey.

Although the growing phase was initiated by governments, Shenzhen's further growing entrepreneurial activities were propelled by Shanzhai copycats, as the early 2000s marked rapid growth and the emergence of specialised players readily available for coordination by future start-ups. Under the context of China becoming the largest mobile phone producer in 2001, as well as the introduction of 2G mobile phones, Shanzhai mobile phone OEMs emerged. In the early 2000s, China's domestic mobile phone vendors had lost huge market share to foreign brands. Meanwhile, China's grassroots huge demand for low-price mobile phones created a terrific market opportunity. It was, however, not until the emergence of MTK's turnkey solution that Shanzhai began to take off. MTK, which is short for MediaTek, is a Taiwanese company that initially produced VCD chips. Having collaborated with many pre-Shanzhai companies that used to produce MP3s and VCDs in Shenzhen, it sensed the potential niche market for mobile phones in China and thus chose to develop mobile phone chips. MTK significantly lowered the barrier to producing mobile phones by providing an integrated total solution for mobile phone chip sets and it was adopted very quickly by Shanzhai mobile phone OEMs.

Around 2005, the Shanzhai manufacturing network was established – TSC (Total Solution Company), ID/MD (Industrial Design/Mechanism Design), EMS (Electronics Manufacturing Service) and Shanzhai OEMs cooperated to manufacture Shanzhai mobile phones. Shanzhai OEMs were mainly responsible for the marketing channels while various specialised firms such as component suppliers, design houses and foundries in Shenzhen were coordinated by Shanzhai OEMs in order to gain capability as a whole. On the one hand, the huge market demand for low-end mobile phones resulting from the increase in rural purchasing power and the surge of overseas demand, greatly promoted Shanzhai's development. On the other hand,

Shanzhai mobile phones' low price – as low as £30 each – together with their abundant features and the company's rapid reaction – releasing a new product within just a month – to both domestic and international demand, also contributed to the prosperity of the Shanzhai market.

Shanzhai reached its peak in 2007. Before 2007, licences issued by the Chinese government were required for the production and sales of mobile phones in the Chinese market. Shanzhai mobile phone OEMs apparently could not get these licences, which effectively made them illegal, although they had operated for many years. In 2007, the Chinese government abandoned the licence control of mobile phones, which ensured Shanzhai's legal status, after years of legitimising efforts. By 2008, it is estimated that there were some 30,000 firms in total collaborating on producing Shanzhai mobile phones in the Shenzhen area. Shanzhai shipments reached 200 million in 2008 alone, accounting for 1/6 of global shipments (Zhu and Shi, 2010). During the 2008-2009 period, Shanzhai not only captured about 30% of China's market, but also exported huge numbers of mobile phones to emerging markets such as India, Brazil and Africa.

As a result, a highly comprehensive and specialised value chain of electronics manufacturing was finally established in Shenzhen – the clustering of various specialised players such as component suppliers, design houses, circuit board providers and OEMs, etc., was so tremendous that one could get nearly any component of an electronic product within 30 minutes' drive. Although Shanzhai manufacturers were not primarily involved with new venture creation activities, what is more important is that the heritage and infrastructure of Shanzhai continued to have a significant impact on the electronics industry and the wider Shenzhen entrepreneurial ecosystem. The accumulation of various resources led to the next phase of Shenzhen's entrepreneurial ecosystem: the Silicon Valley of smart hardware.

Mature: The Silicon Valley of smart hardware (2008-Now)

The 2008 financial crisis also severely affected Shenzhen's electronics industry and the wider ecosystem, as the previous focus of contracted manufacturing was heavily shocked by the reduced demand from multinational companies in developed economies. From then on,

Shenzhen gradually upgraded its ICT industries and developed strong innovation capabilities. This upgrading process was facilitated by both governments in the first instance, and, as the ecosystem resources accumulated, Shenzhen's entrepreneurial ecosystem began to massively nurture new and competitive ventures with considerable technological capabilities.

The efforts that Shenzhen's government made with regard to the upgrading of Shenzhen from contract manufacturing and copycats can be traced back to the mid-1990s, when it was figuring out how to encourage companies to develop their own technologies. A dilemma confronted Shenzhen's government: on the one hand, financial support from government was absolutely essential for the vast SMEs in Shenzhen which basically did not have sufficient funds to conduct R&D, forming a vicious cycle; on the other hand, such financial support would be easily taken advantage of if not properly supervised, which was almost impossible considering the vast number of funded companies. Shenzhen's government solved the dilemma by raising the funding application bar year by year, as a former government official noted:

> *... [W]e started to encourage companies to apply for [government] financial support [for] R&D in 1995. In the beginning it was very easy [to obtain the support] as long as they applied…One year later, when more companies came to us, we asked them to not only set up R&D offices, but also acquire qualified researchers and developers… Then, many companies went to universities to hire scientists and researchers… another year later, the application required specific projects... and the next year we asked for a report of market projection and analysis, etc.... Five years later, we have a few companies who went on the path of independent R&D unconsciously and got used to it… in this way, Shenzhen had the first batch of innovation-driven companies…*

The 2008 financial crisis confronted Shenzhen's government with even higher challenges. Another dilemma emerged: whether they should financially support the traditional contracted manufacturing companies and help them survive, or not, and, if not, Shenzhen's economy would be staggering should the upgrading process not go well. Under huge pressures,

Shenzhen's government boldly decided to relinquish the once outstanding contracted manufacturing label that helped Shenzhen grow to be a prominent manufacturing base.

Fortunately, the booming new venture creation activities, which exploited the abundant resources accumulated from the '3+1 Trading Mix', contracted manufacturing and Shanzhai copycats helped facilitate the upgrading process, as a number of technologically advanced start-ups such as DJI emerged. As can be seen in the section on DJI's entrepreneurial process later in this chapter, its success has largely been attributed to the resources accumulated and provided by Shanzhai. The upgrading of Shenzhen's entrepreneurial ecosystem is also reflected in existing companies; for example, when smartphones surged in China, some Shanzhai OEMs managed to develop their own smartphones and brands to stay alive in the market. Also, some of the previous Shanzhai component suppliers quickly adapted themselves to meet the demand of the smartphone OEMs, such as Sunny Optical Technology, who used to be a camera provider for Shanzhai mobile phones, and which has successfully grown to be one of the largest camera providers for the global smartphone market.

Following the central government's national policy of 'Mass Entrepreneurship and Innovation' encouraging new venture creation activities in 2015, Shenzhen's government has also invested in entrepreneurship education and encouraged universities to set up more events and courses related to entrepreneurship and innovation. Also, to further enhance Shenzhen's innovation capabilities, the Shenzhen government has proactively attracted a few top universities in China and Hong Kong to establish campuses in the region, such as the Graduate School of Tsinghua University and Chinese University of Hong Kong Shenzhen campus.

Shenzhen has now become the best city in China for technology entrepreneurship in the broad ICT industry and is frequently regarded as the Silicon Valley of Hardware[9] due to its mature and comprehensive value chain in terms of electronics products. To date, a mature entrepreneurial ecosystem in Shenzhen with all required resources and specialised elements for

[9] https://www.ft.com/content/2c38ccb8-0ad8-11e6-b0f1-61f222853ff3

start-ups has fully emerged for continuous new venture creation.

4.3.2 Huawei's entrepreneurial process (1984-1998) and interaction with the EE

Huawei is a world-leading Information Communication and Telecommunication (ICT) solution provider. Its products include B2B (Business to Business) solutions and services such as telecommunications equipment, as well as B2C (Business to Customer) products such as smartphones and tablets. Huawei now has over 180,000 employees globally and covers more than 170 countries. However, like any ordinary start-up, Huawei had a humble start in the late 1980s.

The early 1980s was an important time for Shenzhen and China. The then Chinese leader, Xiaoping Deng, decided to open up China again to the world and develop her economy. Shenzhen was established as a special economic zone and thus attracted the earliest batch of entrepreneurs from all over China. Zhengfei Ren, a military veteran, was one of them.

In 1984, Ren became a deputy director of an electronics company in Shenzhen and led the company to develop switching systems. Although it failed, this gave him experience which was valuable in creating Huawei. He left the company and a friend in Shenzhen introduced him to work as an agent selling HAX switching systems. In fact, this became Huawei's initial business. In 1987, Huawei was officially founded in Shenzhen, with only 14 employees and $2600 registration capital. Within six months, the agent business had attracted hundreds of competitors in Shenzhen, but 95% of them failed within a year.

The time when Huawei was established was not actually favourable for an indigenous telecommunications equipment company. One of the reasons that there were so many agents is because China provided tax reductions for purchasing foreign telecommunications equipment in order to rapidly populate the Chinese telephone coverage. This, of course, seriously affected the development of any local companies who tried to develop switching systems themselves.

As of 1989, there were only 200 small Chinese indigenous switching system manufacturers and all of them were in the low-end market. Huawei decided to develop their own products partly because of Ren's personal ambitions to defeat the foreign brands, and partly because this was a seriously huge market – as of 1987, the telephone coverage in China was only 10%. However, at that time, Huawei did not have sufficient technology capabilities and Ren started to seek cooperation from universities in China, just as a senior manager at Huawei noted:

> *After several years' sales experience, Huawei had established considerable marketing channels. At this time, Ren decided to develop Huawei's own products but did not have any technologies. Ren therefore signed a co-development contract with a professor in Tsinghua University and also hired graduates from the professor [for product development].*

In 1990, the first product that Huawei developed, Private Branch Exchange (PBX) switches, based on the product that they agented, was launched on the market. With nearly 600 R&D staff, Huawei started the R&D of PBX (Private Branch Exchange) switches independently, focusing on the rural area consumers. One year later, Huawei's first independently developed product – the BH03 switching system – was successfully released onto the market.

After this time, Chinese indigenous telecommunications equipment companies started to emerge and rise. ZTE, another Shenzhen-based company, independently developed ZX500A PBX switch systems. Shenzhen Changhong also developed its own 2000-line switching systems. The increasingly more competitive market compelled Huawei to develop a new generation of switching systems – C08. In 1992, Huawei started the R&D of C08 and hired a large number of engineers for its R&D division from all over the country to develop this new model. These new recruits include many later renowned Huawei employees, such as Ping Liu, Yinan Li and Ping Guo, who then persuaded Baoyong Zheng to join, who later became the Chief Engineer of Huawei, as one of the early executives of Huawei noted,

> *I entered Huawei after the Chinese New Year in 1993…That year was when Huawei started to massively hire engineers to develop C08… Many later*

influential employees came from that batch… (Q5.2.18)

In order to motivate the early engineers, Huawei was among the first companies to distribute shares to its employees, following the reform of share-holding company policies in China. Huawei also benefited from its proximity to Hong Kong in developing C08, as engineers could get product samples from Hong Kong within one week after the design was settled. The earliest Huawei employees, however, had some hard times in terms of their daily lives in the 'primitive' Shenzhen, such as residence permits – one would have to obtain a residence permit to stay and work in Shenzhen in the 1980s – and safety issues, as there were many theft incidents in Huawei's area. Despite these difficulties, Huawei managed to successfully launch C08 in the Chinese rural market. In 1994, C08 had an initial success in the market, enabling Huawei to achieve sales of 0.8 million RMB. As a result of C08 and its market performance, Zhengfei Ren had the opportunity to talk to the then Chinese President, Zemin Jiang, and appealed to the Chinese government to issue policies that were favourable to Chinese domestic telecommunications equipment manufacturers.

Huawei's technological and R&D capability kept growing. In 1995, an R&D headquarters was set up in Shenzhen and an R&D centre was established in Beijing, with Yinan Li being its first director, to further attract talents to Huawei. In the same year, Huawei's penetration in the rural areas of China was significant and this helped the company achieve sales of 1.5 billion RMB. However, as major Chinese cities including Shenzhen started to deploy GSM networks, Huawei's products followed this upgrading and captured the opportunity to enter the high-end market. In 1996, Huawei won the contracts from China Unicom Shenzhen and Shenzhen Post Office to deploy GSM networks. In the meantime, Huawei started the R&D of the next-generation system, CDMA, supported by the China's 863 national project. By 1997, Huawei had successfully established its presence in major Chinese cities and reached sales of 4.1 billion RMB, with a 60% increase compared to 1995 and 5600 employees.

Following this momentum, Huawei took a brave action. Ren began to encourage senior employees in Huawei to leave and start their own companies. Many of these early employees

either entered other start-ups or started their own companies. Years later, these people became individual investors in the Shenzhen venture capitalist industry.

In 2009, the Exhwer club was established by several previous Huawei senior managers in order to facilitate the cooperation and communication among Huawei ex-employees. This club occasionally held venture investment forums, technology trends forums and entrepreneurship forums. Huawei's contribution to the Shenzhen area is significant in terms of entrepreneurship. It is estimated that nearly 50% of the companies founded by Huawei ex-employees stay in Shenzhen as of 2017[10], and half of these start-ups are in the ICT industry.

Their work experiences in Huawei have no doubt helped the company's former employees in setting up new businesses or working in other companies. In this sense, Huawei's considerable outputs such as human resources, managerial routines and company cultures have spilled over to many other private companies in Shenzhen, including top companies like Tencent, which has many previous Huawei employees as middle to senior management people. Huawei's entrepreneurial process and interaction with the ecosystem are mapped out in Figure 4-8, with major events highlighted.

[10] http://www.jfdaily.com/news/detail?id=75376

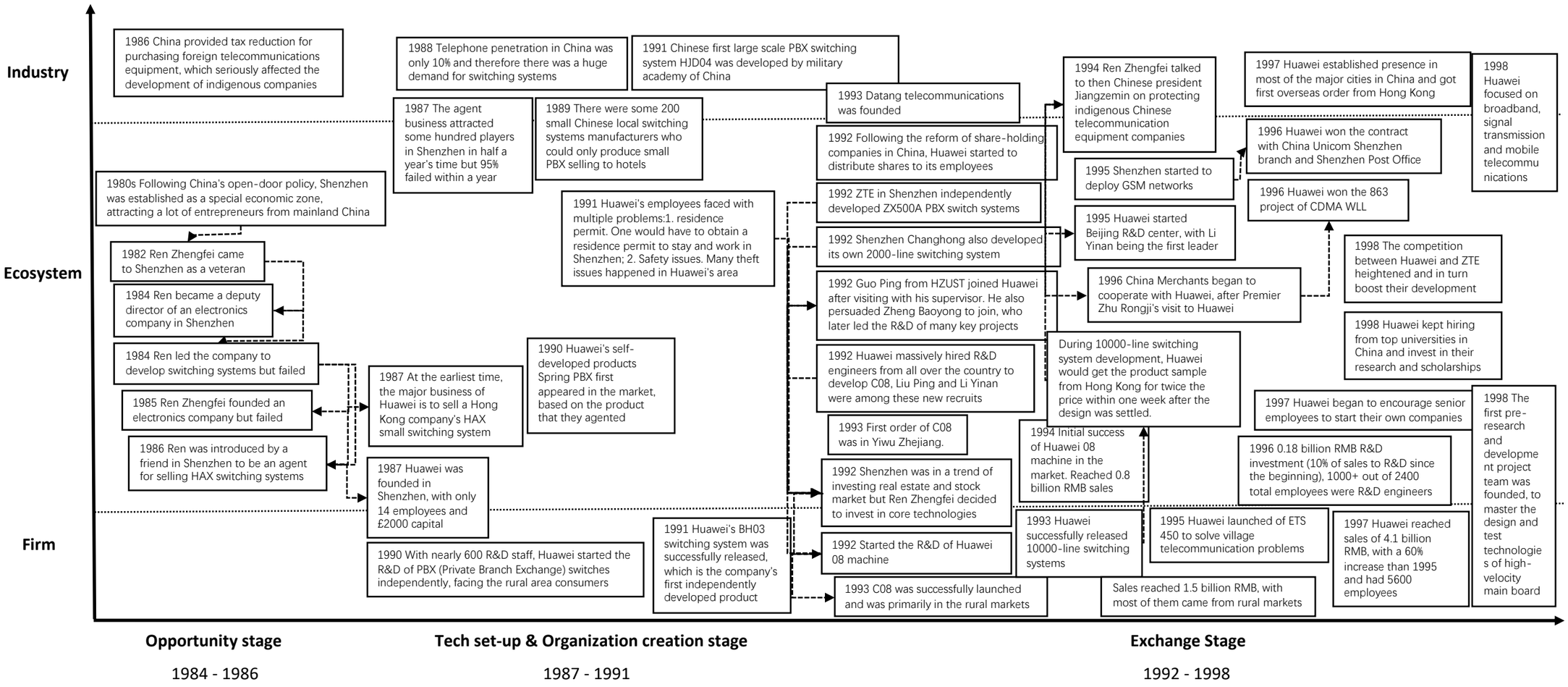


Figure 4–8 Huawei's entrepreneurial process and its interactions with the Shenzhen entrepreneurial ecosystem

4.3.3 Tencent's entrepreneurial process (1996-2004) and interaction with the EE

Tencent is among the most successful Internet companies in China and globally. As of 2017, Tencent's world-leading services include social network, instant messaging, mobile payments, music, web portals, online games and mobile games, etc. Its mobile social app WeChat has integrated many of its current services into one single application and has become Chinese people's must-have app. The story of Tencent began with its earliest endeavour in the field of instant messaging software, QQ, some 20 years ago.

Huateng Ma, also known as Pony Ma, Tencent's founder, came to Shenzhen with his family in 1984. Three years later, he and his co-founders met at Shenzhen High School. After high school, Ma was admitted to Shenzhen University to read Computer Science and Electronics, as were three of his co-founders. In his sophomore year, he developed a keen interest in C programming and, in his final undergraduate year, he undertook an internship in Shenzhen's LiMing Computer Network Co. During this period, he developed a stock market analytical system and sold it to the company for 50,000 RMB.

In 1993, after his graduation, Ma joined the RunXun software company, which was in the paging centre business then. After finishing work, he enjoyed surfing the Internet as one of the first Chinese Internet users. After playing with FidoNet, an online BBS (Bulletin Board System), Ma established FidoNet Shenzhen branch, named Ponysoft, which became very popular among software developers in China. He developed his unique sense of user experiences in maintaining FidoNet Shenzhen branch. Under Ma's influence, Bojun Qiu and Jun Lei, who both later became famous Internet entrepreneurs in China, established FidoNet Zhuhai and Beijing respectively in 1996. Lei Ding, who Ma hosted when he came to Shenzhen as a FidoNet user, developed an email system which made Ding a millionaire. This made Ma very eager to start his own business. As Ma mentioned in an interview later:

I should say that there were influences from Ding. [After his success,] I thought

I could do something in the Internet industry…

In 1996, Zhidong Zhang, Ma's high school classmate, joined LiMing Computers, where he met Ma again and they had an historic conversation about starting their own company together. Initially, their idea was to combine the traditional paging centre business with the Internet. However, at the end of the 1990s, mobile phones started to overtake beepers to become the major communication tool. This endangered their paging centre business. Along with mobile phones and the Internet, an instant messaging software came to Ma and his co-founders' attention – ICQ. ICQ was developed by Israeli developers and quickly became the most popular instant messaging software globally – or it literally created this market. The software was also translated into Chinese and entered the Chinese market in 1998. This is when Ma and his co-founders conceived the idea of developing a Chinese version of ICQ. At the end of 1998, Tencent was formally established, by Ma and his five co-founders, in a state-owned science park.

In the earliest days of its foundation, Tencent had a tough time and the co-founders were willing to undertake any project to raise enough funding to develop OICQ – the Chinese version of ICQ. One of the co-founders, Liqing Zeng, exploited his social networks in Shenzhen Telecommunications and secured an email system development project for Tencent. In the meantime, Zhidong Zhang, led a team composed of former employees from Runxun and some other Shenzhen companies, who used to be users of Ma's FidoNet Shenzhen and were attracted to join Tencent, to develop OICQ. With the support from the funding gained through the project with Shenzhen Telecommunications, OICQ was successfully released.

Compared to ICQ, OICQ had two innovative improvements: one was to retain historical messages on servers in order to enable Chinese customers who did not have personal computers to access these messages on different computers and to read offline messages. Note that this is a very effective approach to attract Chinese customers, as, at the end of 1990s, compared to the US market, personal computers were rare in families and people tended to use computers in Internet cafes. The second improvement was to reduce the size of the software dramatically in

order to enhance the user experience, because the bandwidth in China was very narrow.

After its release, OICQ's number of users increased exponentially, which put huge pressure on Tencent's servers. Due to a lack of money, Zhidong Zhang had to purchase components in Huaqiangbei and assemble a server by himself. A turning point for Tencent in terms of raising money was its participation in the High-Tech Fair. The first National High-Tech Fair was held in Shenzhen in 1999 and it assembled a huge number of technology companies in China, as well as various investors who were keen to see projects with high potential. At the fair, Tencent drew attention from several investors and also successfully advertised itself by giving out many penguin dolls based on Tencent's logo.

Tencent caught a good time – 1999 marked the surge of venture capitalists in China. When Tencent was faced with funding problems, IDG and Yingke Hong Kong set up by Zekai Li helped them out. Although the Tencent co-founders had never heard of VC before, they reached an agreement on the first venture capital investment in Tencent. They were lucky enough to seal the deal before the Internet bubble burst in early 2000.

In 2000, Tencent continued to grow and hired its first employees, who were formerly from Huawei. In fact, many Huawei employees joined Tencent during the 2000s. Meanwhile, OICQ had to be changed to QQ because the company lost a lawsuit against ICQ in the US. Further collaborations with local players continued. Referred by one of the co-founders, Liqing Zeng, Tencent started to cooperate with China Unicom (Shenzhen office) on using QQ on mobile phones running China Unicom's networks. This is different from what we now perceive as using 'apps'. Instead, the service is bundled with SMS (short message service) provided by the network operators. For example, if a user sent an instant message on QQ to a friend who is using the service, even though the recipient is not online, s/he could receive the message via SMS and be able to read and reply via SMS, instead of having to use a personal computer. Anyway, the collaborations turned out to be very successful and was well received by the customers as they were able to use the instant messaging service, which had previously been exclusively on personal computers, 'on the move' for the first time. Following this success,

China Mobile (Shenzhen office), another major network operator in China, decided to collaborate with Tencent in the same way, and it was subsequently introduced to other regions in China.

The year 2001 marked another round of financing for Tencent. MIH from South Africa made a $20 million investment in the company and became its second largest shareholder. The collaboration with major network operators in China went on smoothly and achieved a profit for the first times. Although Tencent was still struggling to search for an appropriate business model for QQ, the number of QQ users reached 100 million. In 2002, Tencent decided to charge new users of QQ a fee for registering and using the software. This angered many potential users and they turned to other instant messaging products. In fact, many Internet giants in China had an eye on this market and one of the biggest competitors, UC, developed by Sina, was released in the market in the same year. Under huge competitive pressure, Tencent had to make QQ free again and look for other ways of profiting from it.

QQ Show – a personal virtual image system – was released and ignited the market instantly. Westerners may find it quite difficult to understand why such a product could be so popular. Culture-wise, Westerners do not lack channels in reality to express themselves in the way they prefer, but this is not the case in China under the traditionally perceived social norm – the way you dress and interact with people is, to some extent, standardised and therefore young people often find it interesting to express themselves online, including dressing themselves online as they wish, be it pop star, hipster or anything reflecting their wildest thoughts. QQ Show provided exactly what they wanted. Another smart move embedded with QQ Show was that Tencent launched a virtual currency system and users would have to convert cash into QQ currency in order to buy new QQ shows. This series of moves established Tencent as the no.1 in the instant messaging market. Following its success with QQ, Tencent expanded into Internet gaming and news portal segments and, in the meantime, prepared for IPO with Goldman Sachs Hong Kong office. It would float on the Hong Kong stock market in 2004. Tencent's entrepreneurial process and its interaction with the ecosystem are mapped out in Figure 4-9.

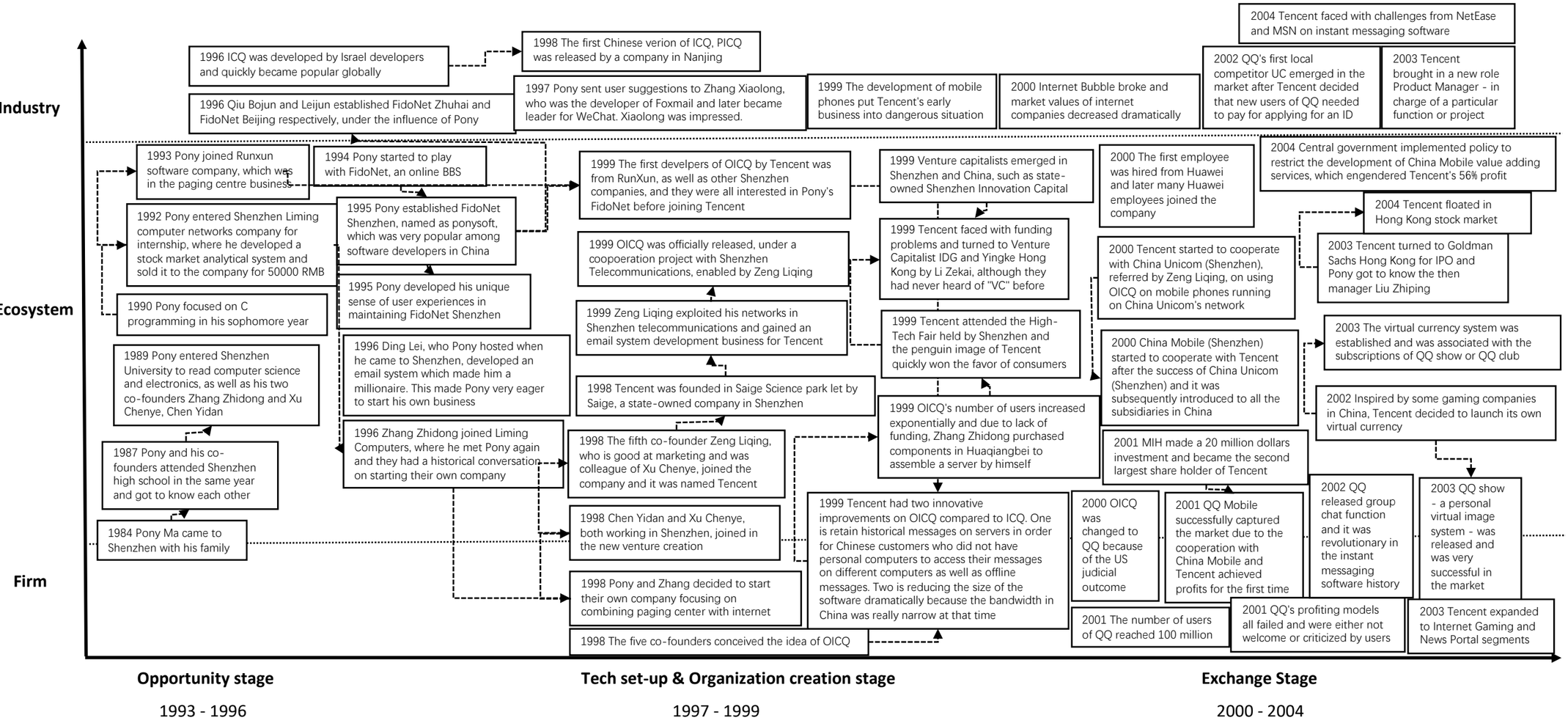


Figure 4–9 Tencent's entrepreneurial process and its interactions with the Shenzhen entrepreneurial ecosystem

4.3.4 DJI's entrepreneurial process (2006-2014) and interaction with the EE

DJI is the top consumer drone company, whose entrepreneurial process and interaction with the ecosystem are mapped in Figure 4-10. As of 2017, DJI captured over 70%[11] of the market worldwide. DJI owns core technologies in flight control systems and platforms for cameras on the drones. The founder, Tao Wang, arrived in Shenzhen in 1993 with his parents, who founded their own business there. Around the same time, his future master supervisor, Professor Zexiang Li, who would later make a significant contribution to Wang's entrepreneurial process, had just joined Hong Kong University of Science and Technology and founded the numerical control and automation lab there. In 1999, the Shenzhen government, Peking University and HKUST jointly established the Shenzhen-Hong Kong Research and Industry Collaboration Centre. As a result of this, Li was asked to found Googol, a motion control system company, at the centre. As a precursor, Googol has nurtured equipment manufacturers, system integrators and complementary companies in the motion control industry, which has contributed significantly to the upgrading of this industry in China, as Professor Li noted in an interview:

> *[I]n the beginning, many entrepreneurs were local farmers who were simply processing raw materials for foreign companies using imported machine tools, taking advantage of the cheap labour… However, this cannot be sustainable, and we need to have our own core technologies in equipment manufacturing, etc., and [a] motion control system is at the heart of the equipment.*

Professor Li learnt from his experiences in Googol that his students would need to be practical – familiarising themselves with Shenzhen's hardware value chains is one of the major tasks of applying theory to practices – and that was what he taught to Wang as well. In 2005, Wang joined HKUST as an undergraduate student majoring in Computer Science and Electronics,

[11] http://www.dronesglobe.com/news/drone-market-share-analysis-predictions-2018/

where he developed a genuine interest in Robotics upon participating in 'Robocon', a Robotics contest held by the university. During this contest, Wang got to know the co-founders of DJI. After the contest, Wang decided to conduct his degree project in developing a flight control system and, as a result, he successfully developed a new technology enabling a drone to hover.

It was about time to build the drone when the enabling technologies were ready. As Wang's master supervisor, Professor Li, suggested that he continue the project in Shenzhen as the value chains are comprehensive and easily accessible. Wang went on to conduct his drone project in Shenzhen, and particularly near Huaqiangbei, where all kinds of electronic component providers were clustered, so that he could source components easily. The beginning was very difficult. In order to get through the early difficulties, Wang had to borrow about $90,000 from a family friend, in exchange for shares in the company. Professor Li also introduced him to a few students from a research centre the professor had co-founded with the Harbin Institute for Technology Shenzhen Graduate School back in 2004. These students would work with Wang on the flight control systems. With all this support, DJI was established in 2006.

The year 2007 marked DJI's first flight control system, XP2.0, being introduced to the market; it allowed a helicopter model to fly beyond visual range for the first time. Its subsequent version, XP3.1, was used in assisting with recovery after Sichuan's earthquake in 2008. DJI continued to grow as Professor Li introduced more students to the company. However, due to some internal conflicts, the founding team broke up. One of the four co-founders, Zhihui Lu, left DJI and joined another Shenzhen company to develop consumer drones. He would later found his own company and continue developing consumer drones. Jinying Chen, another co-founder, went on to establish a new company focusing on First-Person-View solutions for drones and aircraft models. The third co-founder started a company focusing on satellite communications.

In 2010, DJI embraced several successful events that marked its rise in the market. The flight control systems were finally developed and patented and significantly reduced the size of drones. The 'consumer' drone market emerged from this: traditionally, drones were only used by technology and aircraft-model lovers, but DJI successfully created a consumer drone market

by launching relatively smaller and cheaper ($2000 in 2006 to $400 in 2011) drones with excellent videoing functions. DJI began to attract the attention of investors as well as the local government. In 2014, Phantom II and Inspire I were released and ignited the market. These two products made DJI the best consumer drone company globally and it became headline news on famous media such as The Economist and Forbes. In 2015, DJI's market value was estimated to be $10 billion and the company received another round of financing. DJI's entrepreneurial process relied heavily on Shenzhen's vibrant ecosystem, as Wang noted:

> *A very important factor for our success is that we took advantage of the mature value chains in Shenzhen. In fact, at that time, our quantity was not that big, probably some 50 per month. If you are looking for a foundry in the US to help you develop boards and hardware, etc., it would be really difficult [for that small capacity]. Only in Shenzhen, there are some small manufacturers who would be willing to accept your small batch orders. In Huaqiangbei, you can buy a small number of electronic components, although some are refurbished. During that time, we basically established competitive advantages over industry competitors in Germany, US and UK. Although it was a small market then, we successfully beat these competitors. Around 2011, the multiple-rotors market suddenly became very popular. We then put all our accumulated resources and technologies into this market and became the market leader.*

Surprisingly, another reason for DJI's success actually dates back to the 'Shanzhai' phenomenon, which refers to the 2006-2010 period when a huge humber of 2G feature mobile phone manufacturers clustered in Shenzhen and nurtured a comprehensive supply network for producing not only mobile phones but many other consumer electronics. The comprehensive value chain, as noted by Wang and his supervisor, was of course crucial for DJI to flourish. However, another reason behind the scenes was actually the size reduction of electronic components in the development of Shanzhai mobile phones and subsequent smartphones, as the earliest angel investor of DJI noted:

The success of DJI is also about timing. Shenzhen, of course, provides easily accessible components with comprehensive supply chains. But what's more important is that the development of Shanzhai mobile phones and smartphones around 2010 significantly reduced the size of electronic components and these components were used in DJI. This is very important for drones, as battery [power] is limited; to ensure the drone can fly far enough, it has to be small and light – which requires the components to be as small as possible. Another important timing is the popularity of smartphones around 2012…DJI at that time wanted to capture a wider market beyond traditional technology lovers. What they did was to launch a product without the need for assembly by the end-consumers. Instead, consumers can use an app on their smartphone to control their drones to fly straightaway. This further expanded DJI's market.

Benefitting from Shenzhen's environment made Wang and Professor Li better aware of the power of the local ecosystem and they accelerated their steps in giving back to the industry and to Shenzhen: in 2013, DJI started to sponsor RoboMaster robotics competitions every year in Shenzhen and provide further support for winners; in 2014, Professor Li established the Songshanhu Robotics Industrial Park to nurture more robotics companies. As Li noted:

The incubator was established in the hope of attracting more and more talents from Shenzhen, Hong Kong and all around the world to start their own companies in this area…. We can share our experiences and build up a world-class platform for the robotics industry. In 10 or 20 years' time, there could be more unicorns…. We hope DJI and Wang Tao is just a start…

4.4 Summary

Chapter 4 describes the evolution of Silicon Valley and Shenzhen entrepreneurial ecosystems, as well as the key entrepreneurial firms in different phases of development. The rich descriptions provide a basis for research findings in Chapter 5, 6 and 7.

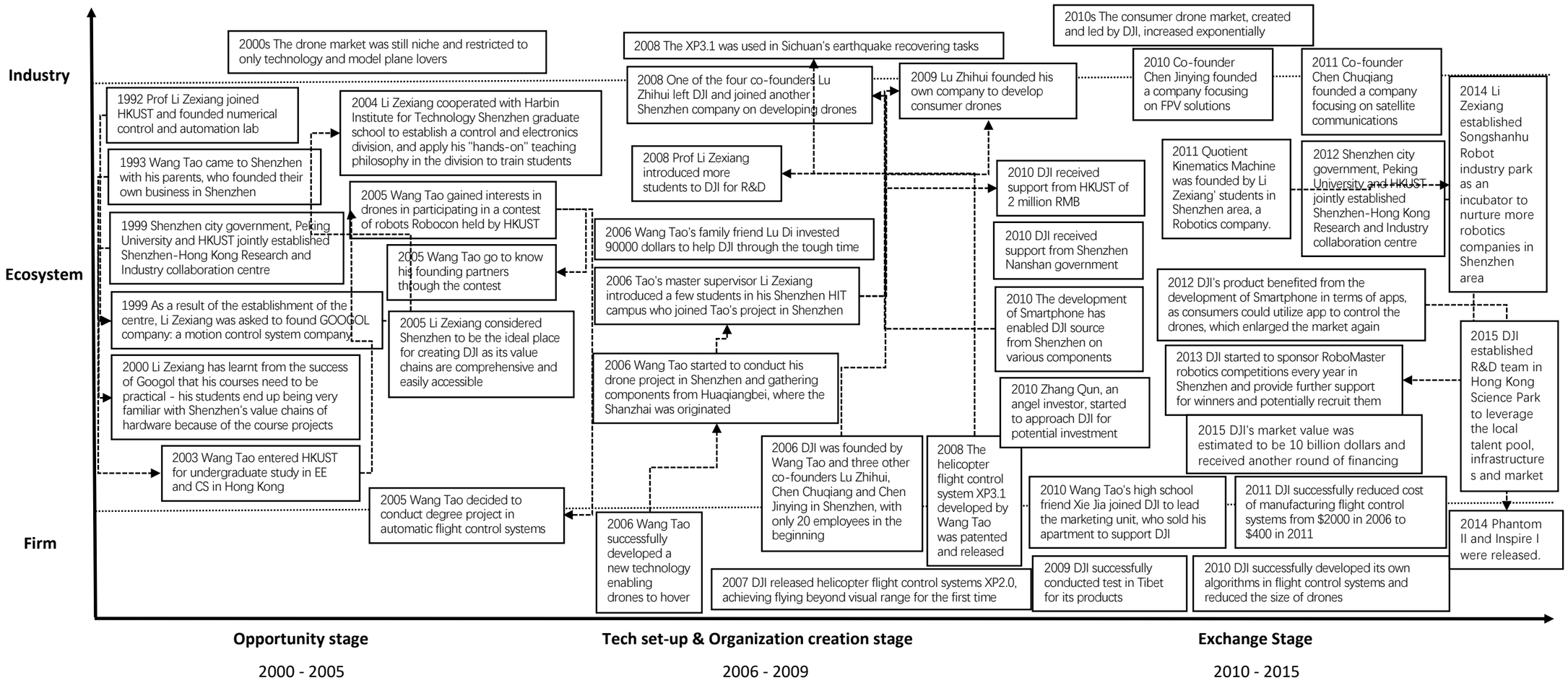


Figure 4–10 DJI's entrepreneurial process and its interactions with the Shenzhen entrepreneurial ecosystem

5. Entrepreneurial Ecosystem Health

> *What we seek are measures of the extent to which an ecosystem as a whole is durably growing opportunities for its members and for those who depend on it.*
> *Iansiti and Levien (2004a, p.32)*

5.1 Introduction

Iansiti and Levien (2004a) pointed out the need to appreciate the novelty of 'health' as a concept to describe the durable or sustained performance of an ecosystem. Similarly, as will be shown later, the entrepreneurial ecosystem health is different from the traditional static dimensions of related concepts, such as determinants of regional entrepreneurships. This chapter therefore sets out to answer the first sub research question 'what are the dimensions for entrepreneurial ecosystem health'.

In this chapter, the main dimensions of entrepreneurial ecosystems and their associated sub-dimensions (axial codes) are derived based on the primary codes obtained from interviews and secondary data, as is illustrated in Figure 5-1. These dimensions include ecosystem resources, entrepreneurial processes, ecosystem performance, ecosystem robustness, ecosystem adaptation, and enabling conditions for the four resource dynamisms – resource replenishment, recycling, diversification and exit. While ecosystem resources, entrepreneurial processes and ecosystem performance entail the traditional static, linear dimensions in understanding the competitiveness of an entrepreneurial ecosystem or regional entrepreneurship, this dissertation adds onto these by delineating the dynamic elements – robustness and adaptation – as well as the conditions that enabled the ecosystems to facilitate such dynamics.

Figure 5–1 Data structure

Prior to elaborating on entrepreneurial ecosystem health, Figure 5-2 shows what an entrepreneurial ecosystem contains, based on extant literature and our findings. It is argued that

an entrepreneurial ecosystem ultimately consists of start-ups and ecosystem resources, which include other actors that are involved in the new venture creation processes.

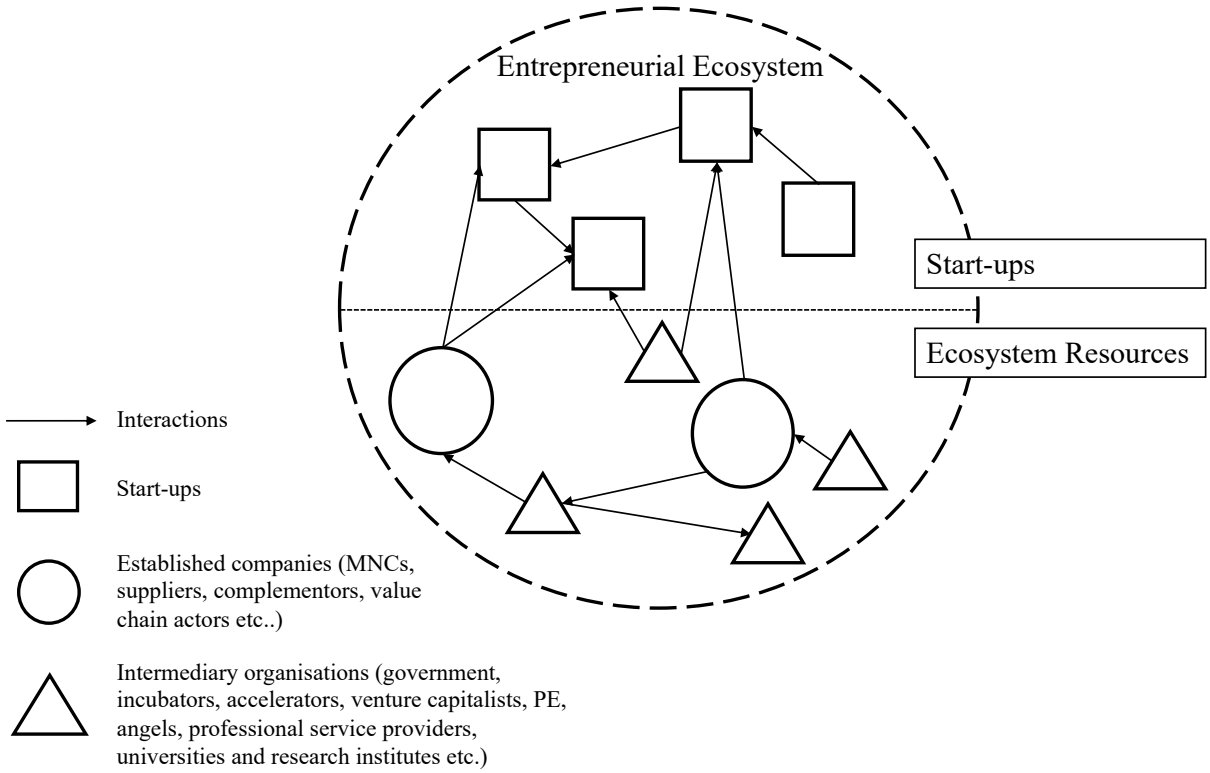


Figure 5–2 Illustration of an entrepreneurial ecosystem

5.2 Ecosystem resources

The resources within an entrepreneurial ecosystem are the fundamental elements that enable it to function properly. These resources together provide a base for start-ups and other organisations involved in the new venture creation process to exploit and leverage. From the primary data, three types of resources within the ecosystems were identified – supply-side resources, intermediary resources and demand-side resources. As is listed in Table 5-1[12] the three different types of resources and illustrative quotes for each type of resource will be

[12] In each table from 5-1 to 5-8, illustrative quotes that are embedded within the main texts are indexed as Q 5.X.X, while those that are not shown in the main texts are presented in full in the table.

discussed in this section.

Table 5–1 Ecosystem resources and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.1.1 *"Manufacturing sectors tend to be neglected here but they did contribute to the rise of the Valley in the 1990s…We were able to acquire Toyota's factory, [at a] relatively lower price due to the economic crisis, to manufacture our cars…" An employee in Tesla*	Production resources	Supply-side resources
Q5.1.2, Q5.1.3	Technology holders	
Q5.1.4, Q5.1.5 *"…Shenzhen is regarded as the youngest city in China – it attracts young talents from different parts of China… The deep human resource base boosted Shenzhen's development over the years…" A senior government official in the Shenzhen government* *"…Also, the diversified talent pool is also a key factor for Silicon Valley's success. People here are highly diversified, with different backgrounds and races. The diversification is critical because, when these diversified people mingle together, there can be new ideas…"A director of an EDA company in Silicon Valley.*	Human capital/talent	
Q5.1.6, Q5.1.7 *"To create a Silicon Valley takes massive, continuous investments. The investments are not just money. At first, they were money and talents. Then they were the VC..." A director in an MNC in Silicon Valley*	Financial capital	
Q5.1.10, Q5.1.11	Social capital	Intermediary resources
Q5.1.8, Q5.1.9	Intermediaries (incubators, accelerators, etc.)	
Q5.1.12, Q5.1.13	Organisational resources	
Q5.1.16 *"…Proximity to market and industry information is key to identify opportunities because electronics companies are clustered here…" A director of an EDA company in Silicon Valley*	Market channels	Demand-side resources
Q5.1.14, Q5.1.15	Customer base	

5.2.1 Supply-side resources

Among the key regional resources, it is found that supply-side resources which enable start-ups to quickly set up their technologies and organisations at the very early stage play a vital role in attracting entrepreneurs and in the prosperity of the ecosystems. The supply-side resources include production resources, talents, financial resources and technologies, which are fundamental resources for start-ups of all types.

Production resources in Shenzhen are crucial for the ecosystem to thrive and adapt. As proximity to production resources such as component suppliers is important for start-ups, especially those in the ICT industry, these resources continuously attract companies from outside of the ecosystem and also nurture companies within the ecosystem. The founder of an

electronics start-up told the author one of the most important reasons for moving to Shenzhen:

> *…the upstream and downstream infrastructures are easily accessible here... It is more important than you might think to get close to where the components are. We are able to make a prototype, test it and revise it very quickly just because we've got manufacturers and component suppliers just on the other side of the street. (Q 5.1.1)*

Another important source of supply-side resources comes from technologies. Evidently, universities and research institutes constitute major sources of new technologies. With the technologies provided by these technology holders, entrepreneurs, who are often the inventors of the new technologies, might be able to transform these technologies into real business. Silicon Valley's early days saw the rise of Stanford University in terms of research first, and then the deep research base of Stanford in turn gave birth to numerous start-ups, amongst which a few become renowned multinational corporations, such as Cisco and Google, as the founder of a venture capital firm in Silicon Valley noted,

> *…Stanford was crucial for the success of Silicon Valley… many academics commercialised their technologies, for example, Cisco and Google, etc.… (Q5.1.2)*

Similarly, Shenzhen witnessed the great potential of commercialising new technologies from the success of DJI, which was born in the lab of Hong Kong University of Science and Technology. Recognising the importance of proximity to technology holders, the Shenzhen government set out to attract more universities to establish a presence in Shenzhen in order to boost the city's innovation capability, as a senior Shenzhen government official noted,

> *DJI is a good example of how university technologies can become bigger and stronger…. We all know that Shenzhen lacks good universities and we are working to attract renowned universities, such as Tsinghua and some universities in Hong Kong, to establish their branches here…(Q5.1.3)*

Local talent pool is another basic source of supply-side resources that enable start-ups to emerge, grow and expand. Since the implementation of China's opening policy in the 1980s, Shenzhen has attracted people with entrepreneurial mind-sets from all over China, as a senior manager in a local consulting firm for regional development noted,

> *People are always the key…. Since the 1980s, Shenzhen has attracted entrepreneurial people from all over China…. You need to know that, in the 1980s, people usually had jobs allocated by the government. Therefore, people who came here at that time were highly risk-taking and self-motivated…. They helped build Shenzhen into what it is now… (Q5.1.4)*

If Shenzhen has gathered some of the best talents in China, Silicon Valley may have gathered some of the best talents from all over the world. The deep talent pool has provided enormous opportunities for the start-ups and mature companies in Silicon Valley to continuously grow and innovate, as a co-founder of an incubator in Silicon Valley told us,

> *Silicon Valley is an immigrant area – almost half of Silicon Valley's working population were not born in the US – and these immigrants are often talented people in their home countries…. (Q5.1.5)*

As one of the most important sources of supply-side resources, financial support for start-ups in both Silicon Valley and Shenzhen is easily accessible, mostly through venture capitalists. For example, a director of a venture capital firm in Silicon Valley told us:

> *…Venture capitals are really big here. Good start-ups would always have lots of eyes on them and they can actually choose whose money they want. (Q5.1.6)*

In Shenzhen, venture capitalists arrived later in the 1990s, but have contributed enormously to the growth of Shenzhen's entrepreneurship, as a senior manager in a venture capital firm in Shenzhen told us,

> *The end of the 1990s was a key milestone for Chinese venture capitalists…*

and the development of VCs directly stimulated entrepreneurship in Shenzhen… (Q5.1.7)

5.2.2 Intermediary resources

Even with all supply-side resources ready to be tapped into, start-ups still face multiple problems in terms of legal issues, investment choices and financing timing, etc. Many intermediary organisations such as incubators and accelerators are aimed at providing a greenhouse for start-ups to grow. These intermediary organisations could provide services that start-ups need during each phase of their entrepreneurial processes, and thus the presence of these organisations could increase the attractiveness of the ecosystems. For example, the CTO of a smart parking app start-up described why he moved to Silicon Valley from the East Coast:

We were selected by Y-Combinator's programme and moved to Silicon Valley at that time…. As a start-up, money, people and supporting services are what we are looking for. And I think Silicon Valley provides us with such an environment for us to grow…. That's why we moved here. (Q5.1.8)

Similarly, in Shenzhen, although incubators and makerspaces only emerged in the last 10 years, these organisations are now coupled with the rapid growth of local entrepreneurship. The co-founder of the first makerspace in Shenzhen described how organisations like his changed the landscapes of regional entrepreneurship:

In recent years, incubators [have been] burgeoning in Shenzhen…. Numbers of makerspaces are also increasing as more and more individuals are keen to try out their ideas…. As the first makerspace in Shenzhen, we saw many talented people who were originally white-collars and teachers, etc.; [they] came to us and tried out their new ideas…. Many of them actually attracted investments. (Q5.1.9)

Social capital is also a critical intermediary resource as social networks between entrepreneurs

and investors are important for both sides to match their needs. With sufficient social resources, entrepreneurs may be able to better leverage other resources, as an individual investor in Shenzhen noted,

> *To be inside the loop is very important. Not only for entrepreneurs who would like to get investments, but also for investors who would like to invest in good projects…. Most of the time [when I make the decision], I look at the founder more than the project (Q5.1.10)*

Unlike the sometimes informal '*guanxi*' networks in Shenzhen, Silicon Valley's social resources are mainly built upon various formal activities such as investor day and entrepreneur networking events; an entrepreneur explained why he attended the investor day in Silicon Valley:

> *…It is a small circle here [in Silicon Valley]…. Attending this [investor day] is a good opportunity to get to know not only investors but also people who have similar interests and to see what else is going on here... these networks may be useful at some point of time…(Q5.1.11)*

Another important intermediary resource is the organisational resource, a term which is used here to refer to best practices, organisational routines, organisational forms and business models, etc. In Shenzhen, the fast and iterative business model of Shanzhai mobile phone manufacturers has inspired many later smartphone companies in China to develop new products with a shorter lifecycle and customised features for specific target market segments, as a senior management of a smartphone company in Shenzhen told us:

> *…[there are] always new species emerging in Shenzhen. For example, Shanzhai mobile phones… many Chinese smartphone companies later benefitted from learning from Shanzhai's quick and iterative approach…(Q5.1.12)*

The take-off of Silicon Valley started right after the birth of venture capital firms, with the founding of Fairchild being the first formal VC investment, which opened up a new way for technology holders to quickly raise funding for their technologies to be commercialised, as a director in a multinational corporation in Silicon Valley noted,

> *…VC is an important invention by Silicon Valley…. A new way of doing things: technology can be exchanged for shares in the start-ups. Venture capital is a key factor for Silicon Valley's take-off. (Q5.1.13)*

5.2.3 Demand-side resources

With supply-side and intermediary resources in the entrepreneurial ecosystems, start-ups may be able to tap into the ecosystems along their entrepreneurial processes. However, although not as evident as the supply-side and intermediary resources, demand-side resources, which include marketing channels and local customers, are also critical. Surely, as more and more companies are born global, the importance of local customers may decrease. However, in a start-up's very early stage, local market acceptance could be a good signal and also help it obtain the first pot of gold. For example, Huawei and Tesla's early orders from local customers helped to maintain their financial stability and gain the opportunity to expand their market into other areas, as a senior PR manager of Huawei noted,

> *Huawei's early success included winning a few contracts with local operators such as China Telecom…. It was difficult to penetrate the market simply because operators trusted foreign brands more than indigenous brands, although with fairly similar quality and much cheaper price from our side…. (Q5.1.14)*

Great importance was also attached to Tesla's early pre-orders from local investors and entrepreneurs. These pre-orders also acted as endorsements from top-tier investors and technology fans, which also had a positive impact on Tesla's brand image, as an engineer at Tesla noted:

> *The early pre-orders from entrepreneurs and investors in the Valley were crucial for Tesla's fund raising…. The cutting-edge design and technologies in the cars fit with technology geeks in the Valley quite well…. [Winning orders from these people] also means that our products are labelled with 'high-end' and [seen as] fashionable in the technology circle. (Q5.1.15)*

Besides end customers, the existing local market channels could also foster market penetration for new companies. In Shenzhen, it is observed that smartphone vendors inherited and utilised the market channels formed in the 2G feature phone era and quickly entered the market, as a senior manager of a smartphone company in Shenzhen noted.

> *…We utilised the channels accumulated during the Shanzhai period of mobile phones. [These market channels are] important for us to reach the customers… especially those in the rural areas who are the major target customers… (Q5.1.16)*

The three types of resources, together, constitute a resource pool, which could be leveraged and integrated by entrepreneurs to create new ventures.

5.3 Entrepreneurial process

The second theme identified is the entrepreneurial process. It is argued that, in assessing the health of the entrepreneurial ecosystem, it is essential to make sense of the effectiveness of entrepreneurs' accessibility to key resources from the entrepreneurial ecosystem, during different stages of their new venture creation processes. Table 5-2 lists the key resource-accessing behaviours in individual entrepreneurial activities and the corresponding illustrative quotes.

In identifying different phases of entrepreneurial process, the author refers to Bhave (1994) and set out to examine the resource dynamisms in the opportunity identification, organisational creation, technology set-up and market exchange/exit stages. It is found that the resource

dynamisms in individual new venture creation processes can be roughly divided into three categories, i.e., resource acquisition in the opportunity and organisational creation stage, resource exploitation in the organisational creation and technology set-up stage, and the resource feedback in the market exchange and exit stage. The three categories will be discussed in the remainder of this section.

Table 5–2 Entrepreneurial process and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.2.1, Q5.2.2 "…Pony and the early co-founders knew each other from high school and some of them even went to the same university… They gathered out of the same passion for the Internet and entrepreneurship…" A senior product manager in Tencent	Looking for co-founders through informal means	Resource acquisition in the opportunity and organisational creation stage
Q5.2.5, Q5.2.6 "After we finalised our VR technology, we participated in several entrepreneurship contests and demonstrations…We also submitted our business plans to several venture capitalists.… Our technology is the key for getting their investments…" A co-founder of a VR start-up in Silicon Valley.	Seeking investments through informal means	
Q5.2.3, Q5.2.4 "The first batch of Google's employees were almost all from Stanford computer science department… Hiring fresh graduates from Stanford and giving them all kinds of perks, such as free food, etc., remains the culture of Google until now" A research scientist in Google	Hiring employees through informal or formal means	
Q5.2.7, Q5.2.8	Developing or acquiring technologies or prototypes with founding teams and employees	Resource exploitation in organisational creation and technology set-up stage
Q5.2.9, Q5.2.10	Expenditure of investment in organisational creation	
Q5.2.11, Q5.2.18 "As we started off, we recruited some of the early software engineers from established companies in Shenzhen, such as Huawei…"A senior strategy analyst from Tencent	Attracting new employees through enhanced formal or informal means	
Q5.2.12, Q5.2.13	Employees or co-founders spin-off to other companies or start new companies	Resource feedback in market exchange and exit stage
Q5.2.14, Q5.2.15	Acquisition by leading companies and dissolving of founding teams	
Q5.2.16, Q5.2.17	New technologies, tacit knowledge or organisational forms/resources spillover to other local companies	

5.3.1 Resource acquisition in the opportunity and organisational creation stage

Before establishing their organisations, entrepreneurs need to access and acquire resources

from the entrepreneurial ecosystems. Specifically, they need to acquire some of the supply-side resources including human resources and financial resources, for example, searching for co-founders through informal means. These could be friends with similar interests, colleagues working on the same projects, etc. DJI's founding team was actually formed while members attended a robotics contest while they were students in Hong Kong, as an executive assistant at DJI noted,

> *Tao and his co-founders met in a robotics contest and they teamed up for the contest, which afterwards led to the co-development of the flight control system that constitutes the key technology of DJI…. (Q5.2.1)*

Similarly, in Google's creation process, Brin and Page actually knew each other when they were reading for a PhD at Stanford University and the same interest in search engines brought them together to work on the PageRank system, as a research scientist described the development of PageRank system.

> *Sergey and Larry both joined Stanford's computer science PhD programme and they got to know each other back then… soon they collaborated on the search engine project, which was the prototype of Google as we now know… (Q5.2.2)*

Early employees are equally as important as the founding teams. In the opportunity and organisational creation stage, start-ups mainly rely on informal means including personal or friends' networks to hire employees to develop technologies in the next phase. When Tencent was founded, some of the software engineers were actually from Ma's previous company, as a senior strategy analyst from Tencent told us,

> *…Many of Tencent's early [employees] are from Pony's previous company Runxun…. When Pony and Zhidong founded Tencent, some Runxun engineers followed them and joined Tencent…. (Q5.2.3)*

When Wang, DJI's founder, was looking for software engineers to co-develop the flight control systems, his supervisor in Hong Kong introduced a few of his students from an institute in Shenzhen, which helped DJI quickly develop and scale up its core technology, as a senior PR manager at DJI told us:

> *Tao's supervisor, Professor Li, had a collaborative institute in Shenzhen with Harbin Institute for Technology…. When DJI was first established, he introduced many of his students to join us… (Q5.2.4)*

Financial resources as one of the key supply-side resources are also critical for the start-ups to survive and thrive. With the human resources acquired, start-ups also need to access financial resources through either formal means such as investments from venture capitalists, or informal means through friends and personal networks. For example, Wang obtained financial support from both his family and his supervisor in Hong Kong, to develop the flight control systems, as the executive assistant at DJI noted,

> *While developing the flight control systems, [Tao] got support from his family members and friends…. His supervisor, Professor Li, in the HKUST also supported him financially in the early days of DJI…. (Q5.2.5)*

Financial resources obtained through venture capitalists are also prevalent in both Shenzhen and Silicon Valley. A senior product manager in Tencent also described how Tencent successfully attracted its first venture capital investment in Shenzhen:

> *The high-tech fair was very important for Tencent…. In the fair, Tencent attracted attention from several investors from Hong Kong although our founders did not really understand the model of venture capital investment… (Q5.2.6)*

5.3.2 Resource exploitation in the organisational creation and technology set-up stage

Entrepreneurs could exploit some of the key supply-side resources including human resources and financial resources to gain further capabilities and create other resources. One of the most important tasks is to develop technologies or prototypes required before entering the market. For example, DJI's founding team members together with early employees developed the flight control system for the drones, as an individual investor who made the first investment in DJI noted,

> *…DJI's core technology is actually its flight control system. For example, how to remain stable while shooting videos…. Tao and his team developed the system in Hong Kong and the team further developed the current flight control system based on that version…. (Q5.2.7)*

Similarly, a senior product manager in the Google search team described how Google's current search engine was developed and what it was based on:

> *Google's core searching technology is based on PageRank, which was developed by the founding team including Larry and Sergey in the early days of Google.... PageRank could illustrate the connections between webpages in addition to just the webpages.... (Q5.2.8)*

Moreover, start-ups also need to complete the administrative work related to the organisational creations, such as legal issues, offices, employee-related issues, etc. Many start-ups choose to enter an incubator and receive a full package for all kinds of services, in exchange for a portion of the investments they have obtained or are about to obtain, as a senior manager in an incubator in Shenzhen told us:

> *We took care of the administrative tasks such as legal services in IP filing, HR services, office handling costs etc.…. Of course when they get investments we*

will take a portion of that as a prior agreement… (Q5.2.9)

Alternatively, some start-ups choose to operate independently, without seeking the help of intermediary organisations such as incubators or accelerators, as a co-founder of a virtual reality start-up in Silicon Valley described their company's development,

> *After getting the investments, we chose to grow independently and rented an office rather than entering an incubator…. The investments enabled us to set up our office and necessary facilities for further development of our products and technologies… (Q5.2.10)*

As the new venture set out to explore the market and prepare for its product launch, more employees are needed. With the financial support obtained, they are able to recruit more engineers or developers to further develop the technology or the prototype; a senior strategy analyst at Huawei described why they hired the first batch of university graduates in Shenzhen:

> *…The first batch of university graduates we hired was in 1994 as we set out to develop C08 [telecommunications equipment] and therefore needed more engineers… (Q5.2.11)*

5.3.3 Resource feedback in the market exchange and exit stage

Perhaps the most significant stage for the entrepreneurial ecosystems in which the start-ups embed themselves is the resource feedback in the market exchange and exit stage. This is because, in this stage, the start-ups will release what they have created into the ecosystem for further exploitation by other start-ups, after successfully exiting the market – either through Initial Public Offering, or being acquired by large companies, or failure in the market.

On the one hand, the founding members or employees could start again in their own companies and create new ventures successively, with the financial returns, experiences and linkages they obtained during the previous new venture creation process. For example, Musk established

Tesla after selling PayPal, as a senior engineer at Tesla noted,

> *Musk sold his previous companies and used the money and resources to set up Tesla and Space X at the same time…. It was tough, especially in the beginning, but he managed to make it through… (Q5.2.12)*

An individual investor who is a former senior sales engineer in Huawei also described how Huawei's employees are shaping the landscape of Shenzhen's entrepreneurship by either becoming investors themselves or establishing their own companies:

> *A lot of former Huawei employees like me became independent investors… and many started their own companies…. There is even a Huawei alumni organisation helping former Huawei employees starting their own businesses. (Q5.2.13)*

On the other hand, many start-ups are acquired by large companies in the ecosystems, resulting in team members joining these large companies, as a senior manager at Google who was a serial entrepreneur described why he moved to Silicon Valley:

> *…Obviously Google, Apple, Facebook – these companies attracted really great talents…. I sold my company to Google and moved here and will stay here for as long as I can…. That critical mass really matters… (Q5.2.14)*

An M&A analyst in the investment department of Tencent in Shenzhen also described how the acquisition works for large companies:

> *We sought strategically for companies whose technologies are complementary and beneficial to ours, as a corporate VC.... We will normally offer them positions in our company after acquiring them… (Q5.2.15)*

In situations where the resources are released to the ecosystem's resource pool, the experiences, tacit knowledge and technologies will spill over to other companies or new ventures in the

ecosystem. For example, many former Huawei engineers and managers joined other companies in Shenzhen and have contributed enormously to the growth of these companies, as a senior consultant to Huawei noted,

> *Huawei can be regarded as the Huangpu Military Academy [West Point of China] for Shenzhen technology companies. [Huawei] contributes many entrepreneurs to Shenzhen…. More importantly, many senior management people in leading companies like Tencent were originally managers from Huawei… (Q5.2.16)*

A former Huawei senior manager who started his own company also described how his experiences at Huawei helped him in his new venture creation process:

> *…Until now, the frameworks of product management, customer-centric thinking and sales techniques [that I learnt in Huawei] have been really important in my entrepreneurial process. (Q5.2.17)*

5.4 Ecosystem performance

Besides the ecosystem resources and the entrepreneurial process in which entrepreneurs access and leverage the resources, the performance of the ecosystem in terms of new venture creations within the region and its impact over regional economic development is a key dimension to consider when assessing the health of entrepreneurial ecosystems. Although these dimensions identified through interviews are well established in the literature (Armington and Acs, 2002), it is worth noting that they are largely outcome-oriented, focusing on the results of regional entrepreneurship. This differs from the notion of ecosystem health in this research, which takes a process view that encompasses the antecedents and the outcomes, as well as the mechanisms of the new venture creations within the region. In the remainder of this section, the two axial codes – regional economic impact and regional entrepreneurship performance – will be discussed, as illustrated in Table 5-3.

Table 5–3 Ecosystem performance and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.3.3	GDP growth contributed by entrepreneurships	Regional economic impact
Q5.3.4, Q5.3.5	Job creations contributed by entrepreneurships	
Q5.3.6	Increased household incomes contributed by entrepreneurships	
Q5.3.1	Number of start-ups generated per annually	Regional entrepreneurship performance
Q5.3.2 "...And also, you really get a bunch of companies who are willing to buy your companies if you are doing well. You have companies like IBM, Amazon, AOL and Google who are prepared to acquire start-ups all the time. This is something very difficult to find elsewhere..." A senior manager in a corporate venture capitalist in Silicon Valley	Well-functioning exit channels for start-ups	

5.4.1 Regional entrepreneurship performance

The fundamental objective for an entrepreneurial ecosystem is to serve new venture creations in the regions. In other words, the direct outcomes of the new venture creations within an entrepreneurial ecosystem are the performance of regional entrepreneurships. Therefore, to evaluate the performance of an entrepreneurial ecosystem, it is essential to assess its actual results of generating new ventures, for example, the number of start-ups generated in high-tech segments including ICT, bio-tech, etc., just as a director of a business network noted:

> *For me, the number of technology start-ups each year is a direct measure for the performance of a start-up ecosystem... (Q5.3.1)*

More importantly, the exit channels for start-ups are also critical. This is because, even though entrepreneurs are generally less risk-averse than average, these channels could mitigate the financial risks entrepreneurs need to take and reduce the perceived uncertainty should the new venture creations fail. Consequently, this could encourage more entrepreneurial activities, as a co-founder of a smart parking app described the typical exiting channels in Silicon Valley:

> *...The exit channels are diversified and healthy here in Silicon Valley. Surely, promising projects can grow to become unicorns.... The Majority can either be acquired by other companies, or simply start again for a new project (Q5.3.2)*

5.4.2 Regional economic impact

Another crucial outcome brought by regional entrepreneurial activities is the contribution to regional economic development. To evaluate ecosystem performance, it is also necessary to consider the impact on regional economic development resulting from the regional entrepreneurial activities. This impact also arguably becomes the major driving force for the Shenzhen government and also the Chinese central government to promote entrepreneurship and innovation, as a senior government official in Shenzhen noted,

> *…We are most concerned with the economic contributions made by promoting entrepreneurships in Shenzhen…. The most direct measure is to see how much more GDP growth the local entrepreneurial activities can generate… (Q5.3.3)*

GDP growth is not the only concern, as a senior manager in a science park in Shenzhen shared his observations on the recent policies initiated by the local and central governments:

> *Entrepreneurship and innovation policy nowadays is a smart policy for the central and regional governments to increase employment rates and promote economic development… (Q5.3.4)*

Since 2015, China's central government has issued a policy of mass entrepreneurship and innovation, which encourages and supports new venture creation activities throughout the country. This has decreased unemployment rates and fostered economic growth. Indeed, the same Shenzhen government official agreed that promoting entrepreneurship and innovation also benefits Shenzhen in terms of creating new jobs and increasing the employment rates, especially for many recent university graduates, who make up a large portion of the total new ventures that have been created:

> *…Another important reason why we promote regional entrepreneurship and innovation policy is to create more jobs, especially for young university graduates… (Q5.3.5)*

The impact on regional economic development is also reflected in the increased incomes and ease of daily life due to new technologies and businesses, as a senior government official in the Development and Reform Commission of Shenzhen's municipal government noted,

> *...As you can see, there are positive impacts of entrepreneurships in Shenzhen on the publics such as the increased ease of daily life, increased average incomes due to increased total outputs [by the new ventures]... (Q5.3.6)*

5.5 Ecosystem robustness

The aforementioned three dimensions largely take a traditional, static approach to examine the competitiveness of entrepreneurial ecosystems and the determinants for regional entrepreneurships. However, it is found find that, as the entrepreneurial ecosystems evolve over time, the resources embedded within them will change, intensify or fade alongside the entrepreneurs' new venture creation processes that involve the acquisition and exploitation of ecosystem resources. This reflects the need to take an evolutionary perspective to examine the anticipated levels of performances and outcomes, in addition to the static measures. In other words, it is essential to capture the dynamics of an entrepreneurial ecosystem in order to fully understand its health.

Table 5–4 Ecosystem robustness and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.4.1, Q5.4.2 *"To create a Silicon Valley takes massive, continuous investments. You need to invest heavily in order to keep in running..." A senior director of an MNC in Silicon Valley*	Attractive to financial capitalists	Ecosystem resource replenishment
Q5.1.6, Q5.4.3, Q5.4.4	Attractive to human capital from diverse backgrounds	
Q5.4.5 *"...Serial entrepreneurs are definitely not rare here. Actually, I would be keen to know about their past experiences of start-ups and these could help me make the decisions" An individual investor in Shenzhen who worked for Huawei*	Serial entrepreneurs, with human, financial and knowledge capital embedded	Ecosystem resource recycling
Q5.4.6	Employees from previous successful or failed start-ups, with knowledge and skills	
Q5.4.7, Q5.4.8	Successful entrepreneurs becoming investors for start-ups in the region	

The ecosystem robustness dimension identified through primary and secondary data actually describes such a situation, where an entrepreneurial ecosystem can sustain its current status and performance without drifting away to potential failure or decreased levels of performances. However, this is only if it is not subject to any external disruptions, for example, major technological change resulting in paradigm shifts and economic crisis that reduces demand significantly for particular segments. In the remainder of this section, ecosystem robustness will be discussed based on the axial codes derived from primary codes and quotes, as is illustrated in Table 5-4.

5.5.1 Ecosystem resource replenishment

The first axial code is the ecosystem resource replenishment in order to keep the ecosystem on track. Specifically, it is found that the replenishment of basic supply-side resources such as human resources and financial resources is critical in maintaining the normal functioning of an ecosystem. This is akin to any power system that needs energy in order to sustain its operations, such as internal combustion engines that need fossil fuels to keep running. The replenishment, from the case evidence, is often from outside of the ecosystem. It can be from other entrepreneurial ecosystems in the same country, or even from outside of the home country. In this sense, ecosystem resource replenishment constitutes a key mechanism for an entrepreneurial ecosystem to be considered robust.

On the one hand, continuously attracting financial resources from outside of the ecosystem can be critical to sustain new venture creations. On the other hand, the attractiveness for financial resources increases as the entrepreneurial activities intensify within the ecosystem. Silicon Valley, which gave birth to the first venture capital investment in the world, is attractive to both financial resources within the US and those from other countries. This arguably becomes the key for the ecosystem to maintain its leading position, as a co-founder of an incubator described the attractiveness of Silicon Valley to investors from outside of the ecosystem:

…Silicon Valley is the home of venture capitalists…. With so many promising

projects here, the Valley attracted a lot of money not only from the East Coast, but also from all over the world…. For example, Chinese investors are now very active here…. This helps the Valley continue to lead entrepreneurship and innovation globally (Q5.4.1)

Shenzhen is also actively attracting financial resources from inland China and Hong Kong, and this has helped Shenzhen entrepreneurs to quickly scale-up their ideas and projects, as a senior investment manager in a state-owned (and one of the biggest) venture capitalist firm in Shenzhen commented:

…For me the [financial] capital is the key. If you look at Beijing, because the capital is very active, the entrepreneurial activities are active…. The same applies to Shenzhen…. Shenzhen is close to Hong Kong where many investors gather… (Q5.4.2)

Besides financial resources, human resources are another important basic resource that an ecosystem needs to replenish in order to sustain its development. Indeed, Silicon Valley has assembled some of the best talents from not only the US but also from all around the world, who are adept at generating new ideas, commercialising and scaling-up technologies. The massive talent pool has provided many possibilities for local companies and start-ups to exploit and reconfigure. A senior director at an MNC described the historical development of Silicon Valley:

To create a Silicon Valley takes massive, continuous investments. But the investments are not just money. At first, they were actually money and talents…. The growing, massive talent pool we have here in the Valley is at the heart of its success. (Q5.4.3)

Similarly, since the 1980s, many people from different parts of China have moved to Shenzhen with their distinctive skills and knowledge. Regarded as the youngest city in China, Shenzhen's entrepreneurial ecosystem has assembled many people with entrepreneurial mind-sets and

visions, which provides a solid base to build generations of start-ups, as a senior Shenzhen government official noted:

> *…Since the open-door policy and Shenzhen becoming a special economic zone, many talents with entrepreneurial mind-sets from other parts of China chose to come to try their fortune…. Now, nearly half of Shenzhen's residents were not even born in Guangdong province and this number is growing every year… (Q5.4.4)*

5.5.2 Ecosystem resource recycling

However, attracting human and financial resources from outside of the ecosystem does not necessarily guarantee the result of a robust entrepreneurial ecosystem. It is equally important to retain these resources in the ecosystem and keep recycling them over time (see also Mason and Harrison, 2006). In other words, financial and human resources attracted from outside can be embedded into the ecosystem resource pool and therefore be repeatedly utilised and exploited in order to create more high-quality start-ups. However, this is not to say that resources should never leave the ecosystem; rather, it is to say that the net resource flow should be positive towards the focal ecosystem, in order to keep the ecosystem robust. If the ecosystem resources keep outflowing, the robustness of the ecosystem will decrease significantly (see also Spigel and Harrison, 2018).

For example, many entrepreneurs become serial entrepreneurs in the ecosystem – they consecutively create new ventures, during which the resources along with the entrepreneurs stay in the ecosystem and are highly likely to be utilised by other entrepreneurs, as a professor described the entrepreneurial culture in Silicon Valley:

> *…We call them exit channels… we don't consider the entrepreneurs as failures even if their companies did not survive…. In fact, there are many serial entrepreneurs who start companies again and again…. Their experience and knowledge accumulated [during their new venture creation processes] are*

valuable not only for themselves but also for others (Q5.4.5)

Another type of resource recycling can be the flow of skilled and experienced employees from a successful or failed start-up to other start-ups in the ecosystem. A senior consultant to Huawei described how important Huawei and Tencent are to the upcoming start-ups after their success in Shenzhen:

> *...Many senior management people in leading companies like Tencent were originally managers from Huawei…. Now that Tencent has grown up, many Tencent employees became entrepreneurs or joined other companies in Shenzhen (Q5.4.6)*

Financial resources can also be recycled, for example, when successful entrepreneurs who profited from their start-ups become investors and invest in other start-ups in the same ecosystem. This is especially the case in Silicon Valley, as a co-founder of an incubator in Silicon Valley noted,

> *...Many investors or founders of venture capitalists are actually entrepreneurs themselves or used to be entrepreneurs who successfully exited their companies, leaving them with a big fortune. They then started to invest in other companies… investors of this type are actually most welcomed by the entrepreneurs because of their experiences and networks… (Q5.4.7)*

In Shenzhen, individual investors who had previously profited from their start-up experiences, came on the scene from the end of the 1990s, when the government relaxed its control of private capital, as an individual investor in Shenzhen who worked for Huawei back in the 1990s told us:

> *...Individual investors emerged at the end of the 90s in Shenzhen…. Many of these investors previously worked for successful companies like Huawei. When they earned enough money, they started to get themselves involved in investing*

[in] other companies in Shenzhen (Q5.4.8)

Together, resource replenishment and recycling ensure the continuous development of the entrepreneurial ecosystems, i.e. the robustness of entrepreneurial ecosystems, on the condition of the absence of external disruptions.

5.6 Ecosystem adaptation

However, sufficient robustness of entrepreneurial ecosystems, marked by well-functioning resource replenishment and resource recycling of basic supply-side resources, does not guarantee the resilience of the entrepreneurial ecosystems from exogenous disruptions. Indeed, from what the author observed in Silicon Valley and Shenzhen, it is often the case that external disruptions brought by radical technological change – such as the migration of 2G mobile phones to 3G smartphones and other highly interconnected smart-devices, and major economic crises such as the one in 2008 that significantly reduced the demand-side resources within and outside of the Shenzhen entrepreneurial ecosystem – will dramatically change the landscape of the entrepreneurial ecosystems.

Faced with such uncertainties and disruptions, for an entrepreneurial ecosystem to remain 'healthy', new resources, both supply-side and intermediary ones, need to be created and embedded into the ecosystem to diversify its resource portfolios, which constitutes a prerequisite for emerging start-ups to adapt to the new environment. Collectively, the ecosystem will then adapt itself to the next possible status which reconciles with the disruptive events. In the meantime, it is also critical for obsolete supply-side and intermediary resources to exit the ecosystem in a timely manner, in order to create more space for the aforementioned new resources to emerge.

Hence, as is illustrated in Table 5-5, the two resource dynamisms, i.e., ecosystem resource diversification and exit, which enable the ecosystem adaptation, are discussed.

Table 5–5 Ecosystem adaptation and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.5.1, Q5.5.2	Emergence of new organisational forms	Ecosystem resource diversification
Q5.5.3, Q5.5.4	Adoption of new technologies	
Q5.5.5, Q5.5.6 *"...The vertical integration led by Intel for the semiconductor industry was the dominant model before the 1980s in Silicon Valley. This means, if you wanted to run a semiconductor company, you needed to have the capabilities to design software to the final wafer production and assembling. This model was inverted in the 1980s due to the rise of EDA [Electronics Design Assistance] industry and contract manufacturing service providers like TSMC in Taiwan. Since then, even a small company with 10 employees can run the electronics business. This is because they can almost buy everything in the market. For example, purchasing software instead of developing independently and having someone else to manufacture for you." A director of an EDA company in Silicon Valley*	Emergence of new business models and business practices	
Q5.5.7, Q5.5.8	Substitution and replacement of existing technologies	Ecosystem resource exit
Q5.5.9, Q5.5.10	Decline and exit of obsolete industry	

5.6.1 Ecosystem resource diversification

The first resource dynamism to enable ecosystem adaptation when facing external disruptions is the ecosystem resource diversification. From what is observed in the cases, three types of emergence of new resources are identified: emergence of new organisational forms, adoption of new technologies, and emergence of new business models and practices. It is argued that these resource diversification activities have enabled the ecosystems to adapt to new environmental and technological challenges, often brought by external disruptions.

Emergence of new organisational forms mainly refers to the emergence of key intermediary resources such as venture capitalists, incubators and accelerators. The emergence of these resources in both Shenzhen and Silicon Valley is key to scale-up the start-ups that are otherwise disadvantageous in terms of both resources and capabilities in the market competition against other established companies. For example, before the venture capitalists emerged, technology holders, usually from universities and research institutions, relied on personal funds or family and friends' funds to start their companies and, even after they had founded the companies, they were unable to obtain financial support from the banks because of the perceived high risks. Although the technologies in this instance may be advantageous, the local ecosystem cannot

scale them up. If other ecosystems utilise such assets and disrupt the market, the focal ecosystem would face substantial challenges of adaptation. The emergence and take-off of venture capitalists in Silicon Valley opened up a new way of new venture creation – entrepreneurs were able to obtain investments that they were not required to pay back should they fail, in exchange for a portion of the potential profits should they succeed in the market. Along with the incubators and accelerators that later emerge, these intermediary resources lower the threshold and barriers to starting a new business, thus providing more opportunities for new technologies or business models to be adopted and diffused in the regional ecosystem. This will significantly increase the adaptability of the ecosystem as a whole, should it face external disruptions in the future, as a senior director at an MNC in Silicon Valley noted,

> *…Then they were the venture capitalists…. They were important inventions in Silicon Valley since the first deal of Fairchild and its successor, Intel…. Other new players like incubators and accelerators are also critical for breaking the bottlenecks… (Q5.5.1)*

The same story happened in Shenzhen at the end of the 1990s. The emergence of new organisational forms such as venture capitalists and incubators, co-working spaces and makerspaces has boosted the regional entrepreneurship and diversified the regional resources, as a senior partner in the top private venture capital firm described the emergence of venture capitalists in Shenzhen:

> *…1999 can be regarded as the year one of Chinese venture capitalists… the central government and the Shenzhen government initiated a few new policies that boosted the entrepreneurship in Shenzhen. One of these policies was to allow the entry of private capital in the market…. Our company was among the first private capitals in Shenzhen. Along with the first state-owned venture capitalist, Shenzhen Innovation Investment, we have invested since then [in] many famous Shenzhen start-ups… (Q5.5.2)*

New organisational forms such as intermediary resources indeed provide more opportunities

for resource diversification. However, in situations such as the presence of disruptive technologies (Bower and Christensen, 1995; Christensen and Bower, 1995) and emerging industries, the existing supply-side resources are just not enough to keep the ecosystem ahead – with the existing suppliers and technologies, it is difficult to upgrade and transform the region into the next stage. In this sense, the adoption of new technologies in time, or even ahead of the others, can be crucial for the ecosystem to gain sufficient adaptability, just as the same senior director in Silicon Valley noted,

> *As the infrastructure gets better and better it might take less investment to create successful start-ups. But you always need to have something new to catch up with the next wave of technology advancements…. It once was semi-conductors and the Internet… in the future it could be artificial intelligence, virtual reality and augmentations… These new technologies enable Silicon Valley to always lead the wave of technology advancements… (Q5.5.3)*

Similarly, in Shenzhen, the upgrading of technologies – and, more importantly, the adoption of these new technologies in other segments – has triggered the ecosystem to diversify its resources through nurturing the next generations of technology start-ups, as an individual investor who was among one of the first investors in DJI in Shenzhen told us:

> *…But what's more important is that [for the success of DJI] the development of ShanZhai mobile phones around 2010 significantly reduced the size of electronic components and these components were subsequently used in DJI…. Similarly, many recent start-ups in robotics benefitted from the development of Shanzhai in terms of value chain and advanced electronic components… (Q5.5.4)*

The emergence of new business models and practices also contributes to the diversification of ecosystem resources, as a senior management of a smartphone company in Shenzhen describes how the business models of Shanzhai – which are highly disintegrated and modularised across the whole mobile phone value chain, resulting in an extremely affordable and responsive

mobile phone portfolio – inform the next generations of smartphone manufacturers, especially those start-ups which are initially resource-poor and technologically disadvantageous, to capture the local market and even lead the global market:

> *The development of Shanzhai companies brought new types of players for technologically disadvantageous local companies, such as the design houses and total solution providers. This highly disintegrated and geographically clustered business model has laid down a solid foundation for the later smartphone manufacturers to thrive…. For example, although we lacked key technological and manufacturing capabilities when we started, we were able to outsource many of these activities and focus on the design and marketing of the smartphones…. (Q5.5.5)*

The practice of distributing shares to employees in a start-up originated from Fairchild and Intel, in order to provide incentives and compensation to employees who undertake the risk of losing their jobs should the start-up fail. As new organisational resources, this practice began in China from Huawei, as a former Huawei employee pointed out how the new practice not only encouraged Huawei employees to work very hard, but also contributes to increasing the financial resources that are used afterwards to invest in other start-ups in the ecosystem:

> *The practice of giving out shares in China to employees for start-ups actually began from Huawei…. Huawei started to distribute shares to its employees after the reform of share-holding companies in China in the 1990s… of course, Huawei colleagues are very hardworking and productive…. When they left the company around their 40s, many of them gained a large sum of money in exchange for the shares… I became an investor in Shenzhen after I left Huawei… (Q5.5.6)*

It is worth noting that our definition of new resources mainly refers to resources that bring disruptive changes in the way of new venture creation in the ecosystems. These changes normally have positive impacts on the new ventures as they address some of the bottlenecks in

the entrepreneurial processes. For example, the emergence of venture capitalists in both Silicon Valley and Shenzhen mitigates the financial restraints in commercialising new technologies and business models; new technologies and applications such as smartphones and related smart devices open up new spaces for both ecosystems to nurture new ventures; new business models such as the disintegrated yet coordinated value chains of Shanzhai built up the foundations for later new smartphone entrants in China; new business practice such as Huawei's distributing shares to employees was emulated by other start-ups in Shenzhen and thus encouraged more talents to join start-ups for higher returns than if they had joined multinationals in the past. With the continuous emergence of new organisational forms, new business models and practices, as well as commercialising new technologies in emerging industries, Silicon Valley and Shenzhen entrepreneurial ecosystems have retained their leading positions in technology entrepreneurships and continuously adapted themselves to the changing environment, when faced with the fast evolution of generations of technologies.

5.6.2 Ecosystem resource exit

However, resource diversification alone only ensures adaptability, not adaptation. When new resources are created, sufficient spaces in the ecosystem resource pool are needed for them to come into existence and function. In this sense, obsolete and inefficient resources should exit the ecosystems, either spontaneously, for example, by the market competition, or passively, for instance, by policies, in order to create spaces for the diversification of new resources. From our observations, the exit of resources is reflected by the replacement and substitution of obsolete technologies, as well as the decline and exit of obsolete and inefficient industries.

The technology substitutions are critical for new technologies to be adopted and, collectively, these new technologies could enable the ecosystem to make the transition to the next phase of development. For example, in the 1960s' Silicon Valley, the emergence of the planar manufacturing process for transistors replaced the traditional manufacturing methods within a few years. The more reliable manufacturing process started Silicon Valley's semiconductor, as a senior director in a semiconductor company in Silicon Valley noted:

The invention of the planar [manufacturing] process by Fairchild in 1959 was revolutionary in the semiconductors industry…. It significantly improved the reliability of the transistors.... In the early 1960s, the planar process replaced the existing manufacturing methods and became the mainstream in the semiconductors industry…. I think Fairchild created the real Silicon Valley by leading us into the semiconductor age… (Q5.5.7)

In Shenzhen, it is also observed how serial substitutions of technologies take place over time, as the technologies and products advance and evolve from beepers to analogue phones, VCDs and DVDs, all the way through to mobile phones and smartphones. These changes were enabled by the Shanzhai cluster, which makes up a comprehensive value chain for later Shenzhen companies to utilise and commercialise their hardware innovations, as a senior manager in a smartphone company in Shenzhen described briefly how Shanzhai evolved:

…Shanzhai cluster actually existed a long time ago since the beepers' age…Shanzhai OEMs continuously renewed their products and migrated from beepers to VCD, DVDs and all the way to mobile phones, and some of them even started to produce smartphones… (Q5.5.8)

Sometimes going along with the technology substitutions, the decline and exit of obsolete industries could provide spaces and release resources to the resource pool for emerging industries to utilise and grow. For example, Shenzhen's ecosystem is exemplary in terms of how obsolete and inefficient industries decline and exit the ecosystem upon external disruptions, in this case, the financial crisis in 2008 that resulted in decreased orders from abroad and increased labour costs. The eventual exit of these industries released resources back to the resource pool embedded in the Shenzhen entrepreneurial ecosystem, which had been leveraged by technology start-ups subsequently, such as DJI, which grew up in a remote area of the Nanshan district yet with easily accessible production resources, as a senior government official in the Shenzhen development and reform commission noted:

The 2008 financial crisis shocked Shenzhen as well. We see the capital-driven

> *and resource-driven industries relocated to other regions because of the decreased orders and increased costs of labour…. However, this created a good opportunity for innovation-oriented companies to emerge and thrive in Shenzhen after the crisis… (Q5.5.9)*

The same government official also traced back to the 1980s when contract manufacturing services were prevalent in Shenzhen and how these manufacturing service providers gradually either relocated to other regions or upgraded themselves as their manufacturing capabilities and experience accumulated over time:

> *In the very early days of Shenzhen, we took over some of the electronic components' contracted manufacturing services from Hong Kong…. Many of these manufacturing services either moved to other regions or upgraded to advanced manufacturing companies who possessed [their] own technologies… (Q5.5.10)*

Along with ecosystem robustness, ecosystem adaptations add to the resilience of the ecosystem, thereby forming dynamic elements when evaluating ecosystem health. However, to achieve ecosystem robustness and adaptations is not without conditions.

5.7 Enabling conditions for resource replenishment and recycling

The first set of conditions serves for resource replenishment and recycling. As can be seen in previous sections on ecosystem robustness, the main resources that need continuous replenishment and recycling are the key supply-side resources such as human resources and financial resources. Therefore, the enabling conditions for resource replenishment and recycling should be attracting and recycling human resources and financial resources continuously. Pertinent to this set of conditions, it is found that attractive living conditions and infrastructure, open-minded and eclectic culture, as well as supportive private and public capital market could enable these two resource dynamisms.

Table 5–6 Enabling conditions for resource replenishment and recycling and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.6.1, Q5.6.2	Moderate and attractive weather conditions and natural environments	Attractive living conditions and infrastructure
Q5.6.3, Q5.6.4	Sufficient education and healthcare systems	
Q5.6.5, Q5.6.6	Receptive attitudes towards newcomers with diverse backgrounds	Open-minded and eclectic culture
Q5.6.7, Q5.6.8 "…Shenzhen has formed a strong culture for entrepreneurship since the 1990s…. At that time, many people from other cities quit their jobs and came to Shenzhen with all their money to start companies…. This city is full of young and talented people who are willing to take risks…"A manager in a robotics incubator in Shenzhen	Entrepreneurial mind-sets – risk taking and serial entrepreneurs; attracting top talents to join start-ups	
Q5.6.9, Q5.6.10	Government/university funding for start-ups	Supportive public/private capital market
Q5.6.11, Q5.6.12	Specialised and mature capital market and funding providers: angels, venture capitalists, corporate VCs, and private equity, etc.	

It is quite straightforward to understand why resource replenishment and recycling require the same conditions. This is because these two mechanisms serve for attracting and retaining talents and financial resources, sometimes competing with other entrepreneurial ecosystems for these resources. Therefore, they do not involve the creation of anything new. Human and financial resources are largely free to flow to any ecosystem that meets their living and career demands at one particular time. To retain these resources, the ecosystem, therefore, has to sustain the conditions that initially bring them in. The underlying assumption here is that human and financial resources are homogenous, including their intentions to move in and what conditions could align with these intentions. This may not be true from the individual's perspective, but from the entrepreneurial ecosystem's perspective, human and financial resources *involved in new venture creations* can be treated as largely homogenous. The interviews with key informants in the two ecosystems indeed aggregate to the three conditions, as is illustrated in Table 5-6.

5.7.1 Attractive living conditions and infrastructure

Attractive living conditions and infrastructure (Florida, 1995) are essential to continuously attract talents to a region. This is a rather basic condition for any ecosystem that attempts to

attract and retain talents. A co-founder of a venture capital firm in Silicon Valley described why the Valley's climate is an important factor for the continuous inflow of talents:

> *…the difference is that people really want to be here…. Silicon Valley's temperature in winter time is 10-15 degrees Celsius, in summer time probably 20-25 degrees Celsius. So, very attractive weather. Actually, if you look at other places in the California, their weather is not as good as here. In the summer, from April to November, it never rains. Never worry about anything like rains coming down… (Q5.6.1)*

Similarly, located in the southern part of China and situated next to Hong Kong, Shenzhen's natural environment and climate are comparatively more pleasant than some of its northern rivals such as Beijing. The founder of an electronics company in Shenzhen also mentioned how the recent haze in cities like Beijing and Shanghai affects entrepreneurs' decisions on, for example, where to start their companies:

> *…Shenzhen's climate is very pleasant. It is warm in winter time and not too hot in the summer. Also, it is close to the sea and we can enjoy good scenery at the seaside…. More importantly, nowadays people are trying to escape from the haze, which is, as you may know, very serious in Beijing and Shanghai. Shenzhen's air quality is much better than the two cities… (Q5.6.2)*

In the Shenzhen interviews, the author was also frequently told that education and healthcare systems are the key factors when many entrepreneurs, especially the ones that typically relocate with families, decide where to start their companies. The Shenzhen government's recent efforts in building better education and healthcare systems show the importance of local infrastructure, as a senior government official in the Health Commission of the Shenzhen government noted:

> *…We are catching up fast in terms of education such as quality of high schools, and healthcare systems, for example, we bring in Peking University affiliated hospital…. These are important for people who come to Shenzhen and settle*

down… we still have a long way to go though, compared to Beijing and Shanghai… (Q5.6.3)

A senior manager in an incubator in Shenzhen also believes that having good universities could be a key enabler for attracting and retaining resources, especially talents, but Shenzhen currently does not have a reputable university which could serve the purpose that Stanford and Berkeley serve in Silicon Valley:

…. What Shenzhen [lacks] are good universities…. It's not only about research, but also about talents…. If you look at Silicon Valley, Stanford and Berkeley could provide such a large number of talented graduates every year for the region… (Q5.6.4)

5.7.2 Open-minded and eclectic culture

The second condition in enabling human and financial resource replenishment and recycling in the region is an open-minded and eclectic culture. From the data, there are actually two different aspects of the local culture that influence the new venture creation in the entrepreneurial ecosystems. The first one is to have a receptive attitude towards newcomers with diverse backgrounds. This is essential for attracting and especially retaining immigrants with different backgrounds, beliefs and customs. As a city with no more than 40 years' history, Shenzhen is famous for its inclusive culture towards immigrants from other parts of China, as the founder of an electronics company in Shenzhen described how he perceived Shenzhen's attitude towards immigrants and how this takes form:

…Shenzhen is a very young city. Unlike many other cities in China, it is so friendly and tolerant to newcomers. We often say, once you come to Shenzhen, you are one of the Shenzhen citizens.... This is very rare in other cities because essentially Shenzhen does not have any historical traditions or burdens; it provides all people from all over China [with] equal opportunities…. (Q5.6.5)

Silicon Valley is even more diverse than Shenzhen, as the former includes many immigrants from all over the world well beyond the boundary of the US. Similarly, the Valley also adopts an open-minded and inclusive attitude towards immigrants, as a CEO of a start-up based in San Francisco noted:

> *....Silicon Valley is a culturally diverse area with many immigrants from other places in the US and other countries such as China, Europe and India…. It is very open-minded and inclusive… (Q5.6.6)*

The other aspect is the social perception of entrepreneurship and especially towards the possible failure of new venture creation. This is important for entrepreneurs who undertake huge opportunity costs to justify their choices. Moreover, it could assist entrepreneurs acquire resources in the ecosystem such as talents, as people are more likely to join a start-up if the entrepreneurial culture is deeply rooted in the ecosystem. As the world's entrepreneurship centre, Silicon Valley has a long tradition of having an extremely positive attitude towards entrepreneurship and failures in the new venture creation process (see also Saxenian, 1983, 1990, 1991, 1996). A senior manager in a corporate venture capital firm in Silicon Valley noted,

> *...People are not afraid of failure and that's always the case here in the Valley. Of course, failure still matters. However, here in the Valley, there are so many investors, who have made enough money to sustain that number of failures, without bringing any personal impact to themselves.... I'm not only talking about the entrepreneurs; you can see it has become a trend for talented people to join start-ups as a prioritised career choice. (Q5.6.7)*

Though relatively young, Shenzhen's entrepreneurial culture has also become prominent since the 1990s, when the first high-tech fair was held, and private capital was allowed into the venture investment market. The entrepreneurial culture was further reinforced when some of the 1990s start-ups became market leaders in their respective industries, such as Tencent, as an individual investor in Shenzhen who worked for Huawei told us:

...I would say this is a good time for people to start their own companies in China, especially in cities like Shenzhen…. The serial entrepreneurs we've just talked about were not actually positive in the past…. However, in China, we are pretty proud to use such a title nowadays…. This shows the tolerance the Shenzhen ecosystem demonstrates to its members… (Q5.6.8)

5.7.3 Supportive public and private capital market

The third condition for replenishment and recycling of resources is the presence of a supportive public and private capital market. In both Silicon Valley and Shenzhen, it is found that one of the key enabling conditions for the financial resources, either from the public sector, or from private investors, is that the ecosystem should have a relatively supportive public and private capital market that ensures the financial resources flow in from outside of the ecosystem and recycle in the ecosystem following the exit of the funded start-ups.

In Shenzhen, government financial support from all levels including the central government, provincial level and the Shenzhen city government level is prevalent in universities and endorsed incubators and/or co-working spaces, as a professor in a Shenzhen research institute affiliated to the Chinese Academy of Science described the financial support received from governments for entrepreneurial activities in his institution:

…You can see the recent support from both central government and Shenzhen government is very strong. [They] invested a lot in the universities to start entrepreneurship courses and workshops…. We also have two government-endorsed co-working spaces here, which receive support from both central government and Shenzhen city government… (Q5.6.9)

In Silicon Valley, although the private capital investments are much more pervasive, the US government or government-related institutional support such as from the National Science Foundation ensures that leading universities such as Stanford and Berkeley can continuously conduct their cutting-edge research and commercialise the resultant new technologies, as a co-

founder of a technology and industry news media in Silicon Valley noted,

> *...Stanford and Berkeley have the best research and technologies. Many [of the] newest technologies are used in their labs and then diffused and applied to other companies and industries. Unlike in the industries, Stanford and Berkeley receive a lot of money for research and technology commercialisation from the governments and related institutions, and these universities encourage entrepreneurship out of the new technologies…. (Q5.6.10)*

However, financial resources from the public sector are rather limited and many such resources are required to be used in research rather than directly in commercialisation. Therefore, a supportive private capital market ensures the dyadic interaction between investors and entrepreneurs – investors could seek appropriate channels to invest in start-ups and start-ups could find different types of investors in different stages of their entrepreneurial processes, as a senior manager in a corporate venture capital firm described the funding cycle of start-ups and division of labour in the capital market in Silicon Valley:

> *...So, in the funding cycle of start-ups, you typically see people start by borrowing money from friends and family, and you do the very first prototype with two or three people in the garage, then you go to angels typically, and you get the first institutional fund, which is normally 100,000 to 500,000 dollars, to help you create the organisation and make something interesting for the market. Then you go to a VC for round A to make the first real product; [after that] you get to round B or round C, which is normally for extending your market and being able to recruit people to sell your product, and then the further rounds are scaling-up the company… but as a corporate VC we don't get involved in the first two to three rounds and we are looking for things that are proven to be feasible in the market…(Q5.6.11)*

Similarly, in Shenzhen, specialised investors in different stages enable the financial resources to flow and, most importantly, to recycle in the ecosystem when successful entrepreneurs

reinvest their profits through these channels, as a senior investment manager of a venture capital firm in Shenzhen noted:

> *…The start-up investment ecosystem is very mature in Shenzhen. We have different and specialised funders in different stages of new ventures. For example, the angels who invest mainly [at] the very early stage; the venture capitalists who focus on the early to middle stage; and also private equities who invest in later stages…. The structure is clearly divided and specialised. (Q5.6.12)*

5.8 Enabling conditions for resource exit

The second set of conditions serves for resource exit, as is illustrated in Table 5-7. As can be seen in section 5.5, the main resources involved in resource exit are the renewal of key supply-side resources including the substitution of existing technologies and the exit of obsolete industries. Therefore, the conditions for resource exit are mainly concerned with enabling the technology substitutions and facilitating the exit of obsolete industries. It is found that highly re-combinative industrial architecture and facilitating techno-industrial substitutions are the two enabling conditions.

Table 5–7 Enabling conditions for resource exit and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.7.2	Focusing on industry with high embeddedness in the global value chains	Highly re-combinative industrial architecture
Q5.7.1 "Silicon Valley is so successful – not because it catches every wave of technology, it instead creates every wave of technology…. Think about smartphones, electric cars, artificial intelligence…. This is made possible by the huge advantages in research not only undertaken in Stanford University, Berkeley and national laboratories, but also companies like Google and IBM research in Silicon Valley…." A senior director in a research institute affiliated to a multinational corporation in Silicon Valley	Diversified technology base with deep research base	
Q5.7.3, Q5.7.4	Facilitating the emergence and substitution of new technologies	Facilitating techno-industrial substitution
Q5.7.5	Nudging industry upgrading with policies and initiatives	

5.8.1 Highly re-combinative industrial architecture

As the first enabling condition for resource exit including the substitution of obsolete technologies and industries, a highly re-combinative industrial architecture (Jacobides, Knudsen, and Augier, 2006; Jacobides, MacDuffie, and Tae, 2016) means more adaptability and fluidity for companies in the entrepreneurial ecosystems when new technologies and paradigms invert the industry. With this condition, the ecosystem could eject the industries that are no longer efficient and recombine the existing and any new resources to establish new industries, which consequently enable the ecosystem to achieve longevity and prosperity. In both Silicon Valley and Shenzhen, the presence of this condition, and the consequent adaptability for the two ecosystems are observed. However, the two ecosystems meet this condition in two different ways.

Silicon Valley acquires the re-combinative industrial architecture by leading the ICT industry through its technological superiority, mainly because of its deep research base that includes world-leading universities such as Stanford University and the University of California Berkeley, as well as first-class research institutes affiliated to multinationals such as IBM research, Xerox Silicon Valley research centre and Google's research department, etc. With its deep research base, Silicon Valley could maintain its technological edge and disrupt itself before being disrupted by others, just as a co-founder of a venture capital firm in Silicon Valley described:

> *…. Another difference Silicon Valley has against some other places, for example, the Taiwan Hsinchu, is that Silicon Valley keeps reinventing itself. Technologies move forward, so if you look at the Silicon Valley that started in the 1960s, every 10 years, new companies with new technologies emerge and take over…. This is made possible because of the strong research institutes and universities here in the Bay Area… (Q5.7.1)*

As a young city in an emerging economy, Shenzhen does not possess such strong research

capabilities. However, Shenzhen takes a different approach to obtain a highly re-combinative industrial architecture through companies focusing on positions with high embeddedness in the global value chains. In other words, Shenzhen successfully has successfully embedded itself into the electronics global value chains. Therefore, whenever Silicon Valley leads a technological change in the electronics industry, Shenzhen can find itself contributing to the manufacturing and key component supply, by re-combining the resources and capabilities accumulated in the previous technological paradigm. More importantly, this enables generations of start-ups to utilise the flexibility in resource reconfiguration to quickly scale-up in the new paradigms. In this way, Shenzhen's ecosystem successfully sustains itself and rapidly adapts to the volatile industrial landscape. A senior official in the Shenzhen government's technology and innovation commission described Shenzhen's historical development and the Shenzhen government's approach in supporting local industries:

> *…. We [Shenzhen government] do focus on specific industries…. Of course you always prefer the so-called high-value companies, but we do not disregard those who hold important positions in the value chains but are rather small, particularly those who are deeply fused into the global value chains. To be honest, these companies might well survive longer than others. For example, in the transition from feature phone to smartphone, a lot of Shenzhen mobile phone companies did not make it but companies who provide key components such as batteries and camera components survived and did even better because, essentially, smartphones still need these components…. (Q5.7.2)*

5.8.2 Facilitating techno-industrial substitution

A highly re-combinative industrial architecture only serves as a necessary condition for the substitution of obsolete industries and technologies. However, to sufficiently ensure the resource exit, the ecosystems need to be able to proactively drive and facilitate the techno-industrial substitution. In Silicon Valley and Shenzhen, two different mechanisms in facilitating techno-industrial substitution are observed.

In Silicon Valley, market mechanisms play a major part in driving the substitutions. New technologies will be tested in the stiff competition with many other solutions in the market, and the winners will prevail, without non-market interventions, as a senior employee in a multinational corporation in Silicon Valley described:

> *…Silicon Valley is a purely market-driven ecosystem…. There is nearly no government intervention, but the market will decide who should survive…. People always come up with new technologies every day and, as long as they can prove themselves in the market, they will prevail and substitute the existing technologies or solutions… (Q5.7.3)*

However, as an entrepreneurial ecosystem in an emerging country, Shenzhen faced a different problem – how to upgrade and move up along the global value chains. Recall that Shenzhen achieves the first enabling condition by embedding itself into the global value chains to increase flexibility and adaptability when faced with disruptions of new technologies; however, there are risks of being stuck in the low value-added manufacturing sectors, with the most prominent risk being that of increased labour costs, which means the model simply cannot sustain in the long term. Secondly, being stuck in the low value-added manufacturing sectors means more risk of being replaced by other emerging ecosystems, which could consequently cause the focal ecosystem to decline. For example, the 2008 financial crisis hugely affected the global economy and Shenzhen's electronics manufacturing, especially when many companies were actually providing electronic manufacturing services to multinationals, as the demand decreased significantly, and the labour costs increased due to the increasingly tightened labour law in China. Since then, the Shenzhen government and Guangdong provincial government have promoted the transformation and upgrading of the local industries by intentionally encouraging the development of emerging industries and facilitating the exit of obsolete ones, just as a Shenzhen government official commented on Shenzhen's success:

> *…We shift our focus to nurturing strategic emerging technologies and industries such as electric vehicles, smartphones and drones, etc., instead of*

sustaining the old ones. We call this 'vacating the cage to change bird'…. (Q5.7.4)

A senior director in a robotics incubator in Shenzhen also pointed out that, in contrast to many other cities in China that sustained the obsolete industries with financial support from the government, Shenzhen's government proactively encouraged the exit of these resources and created spaces for new ones to emerge, with the risk of a significant drop in local economic growth during the transition:

[The] Shenzhen government was under pressure after the financial crisis…. On the one hand, they were pressured because they let go the companies who were closed down due to the crisis, which slowed down the economic growth data significantly…. On the other hand, they were concerned with whether new companies could actually come in…. Fortunately, Shenzhen indeed upgraded itself from copycats to independent innovation…. Looking back now, I think [the] Shenzhen government really took a smart move by intentionally facilitating industry upgrading… (Q5.7.5)

5.9 Enabling conditions for resource diversification

The third set of enabling conditions is concerned with resource diversification. As can be seen in section 5.4, the resource diversification mainly involves the emergence and adoption of new technologies, new business models and practices, as well as new organisational forms. When tracing back to the data to examine how these new elements emerge and what enables them to emerge, it is found that formation of weak social ties, transformation from weak social ties to strong social ties, modularised industries and new venture creation process, as well as moderate institutional environment and appropriability regimes are the conditions to facilitate resource diversification in the entrepreneurial ecosystems, as is illustrated in Table 5-8. The second and third sets of enabling conditions respectively for resource exit and diversification together precipitate the entrepreneurial ecosystem adaptation.

Table 5–8 Enabling conditions for resource diversification and illustrative quotes

Illustrative Quotes	*Primary Codes*	*Axial Codes*
Q5.8.1, Q5.8.2	Establishing technology entrepreneurship clubs or societies, informal activities for start-ups and entrepreneurs	Formation of weak social ties
Q5.8.3, Q5.8.4	Establishing formal business networks/activities/relationships for start-ups and (potential) entrepreneurs	
Q5.8.5, Q5.8.6	Start-ups and founding teams' formation from informal activities for start-ups and entrepreneurs	Transformation from weak ties to strong ties
Q5.8.7, Q5.8.8	Start-ups, business collaborations or investments initiated from business networks/formal activities/relationships	
Q5.8.9, Q5.8.10 "...Multinationals do what they need to do…. Small companies and start-ups do what they are adept at. This means the ecosystem has big trees, flowers and also grass. So, there is relatively less nasty competition. This is good for innovation when small companies emerge continuously and try to invert the big companies…"A co-founder of a technology and industry news media in Silicon Valley	Fragmented industries and specialised companies along the value chains	Modularised industries and new venture creation process
Q5.8.11, Q5.8.12	Specialised players/organisations in each of the new venture creation activities	
Q5.8.13, Q5.8.14	Idea/best practice sharing/open to visiting and mutual learning	Moderate institutional environment and appropriability regimes
Q5.8.15, Q5.8.16 "…The government, at first, turned a blind eye to Shanzhai companies and even made them legitimate although still illegal…. Objectively speaking, although this was not good practice for IP protection, the development of Shanzhai actually helped Shenzhen get rid of Shanzhai in a short amount of time…" An individual investor who was among one of the first investors of DJI in Shenzhen	Reasonably loose institutional environment and government policies regarding IP	

5.9.1 Formation of weak social ties

The first condition is the formation of weak social ties. Weak social ties (See also Granovetter, 1973) among players involved in the (potential) new venture process serve the purposes of building further, strong ties. In the entrepreneurial ecosystem setting, weak social ties can be formed when multiple parties who are interested in creating new ventures or being involved in the new venture creation, such as venture investment, bringing start-ups into incubators, or simply searching for potential co-founders, take part in formal or informal activities and interact with each other. These activities can be investor days held by investors or incubators, technology fairs, as well as entrepreneurship and technology-related societies/clubs activities

such as seminars and demonstrations. When these different ecosystem players interact with each other and get to know each other, weak social ties form. The formation of weak social ties is an enabling condition precisely because it serves as the prerequisite for these ties to transform into strong ones, which often yields the emergence of new technologies, new business models and new organisational forms.

From the data, two types of weak tie formation are identified. One is through informal means such as informal activities for start-ups and entrepreneurs in technology- and entrepreneurship-related clubs or societies. For example, in Apple's entrepreneurial process, both co-founders joined the Homebrew Club in Silicon Valley and gained their first order from the club. They also hired one of the organisation's first employees from the club. Similarly, in Google's entrepreneurial processes, the two co-founders knew each other from orientation activities at their university and were further connected by their similar interest in search engine algorithms. With a vibrant entrepreneurial community, Silicon Valley has numerous societies that aim to help members create their ventures, although many of them are not even designed to be traditionally perceived entrepreneurship societies. For example, in an interview with a founder of a venture capital firm in Silicon Valley, the author was told that the founder's alma mater has an alumni association in the Bay Area which periodically organises events to connect alumni who are interested in starting their own companies. This type of informal means facilitates the formation of weak social ties when potential collaborators mingle through the informal activities.

> *...As a committee member of the TEEC [Tsinghua Entrepreneurship and Executives Club] supporting Tsinghua alumni for entrepreneurship since 1995 in Silicon Valley, we are very active in the Bay Area to host activities for entrepreneurships and financing, such as venture contest and investor day, etc. Societies like us in the Bay Area are countless and these provide a valuable platform for exchanging information and ideas…. (Q5.8.1)*

In Shenzhen, it is also evident that various activities organised by ecosystem actors such as

incubators and venture capitalists contribute to the formation of weak social ties among the local start-up communities, as a senior manager in a Shenzhen incubator noted:

> *…We have activities regularly for entrepreneurs or people who are generally interested in entrepreneurship, such as seminars, successful entrepreneurs' experience sharing, round-table discussions, investor Meet&Greet, etc.…. This could foster the communications in the local entrepreneurship community… (Q5.8.2)*

Besides the informal approaches, formal means such as attending technology fairs and entrepreneurship and/or technology contests, evident from the data, also play an important part in the formation of weak social ties. For example, DJI has organised a robotics contest in China every year since 2013, hoping to gather the best Chinese robotics talents and create opportunities for them to share their ideas and thoughts as well, as a manager of the public relations office in DJI told us:

> *…Since 2013, we've held the RoboMaters China robotics contest every year in Shenzhen. We attract many teams from top universities in China to participate in the contests…. Except for the contests, we also have summer camps, clubs and robotics-related courses for the participants in order to improve their skills and increase their interest in robotics…. Actually many teams in the past went on to establish a robotics company with our financial support… (Q5.8.3)*

Interestingly, as can be seen in DJI's entrepreneurial process, the founding team members knew each other from attending a robotics contest in Hong Kong and together they built the flight control system which later served as the company's core technology. In fact, in Shenzhen, the government has also played an important role by acting as the medium and creating opportunities for the formation of weak social ties in various formal means, such as organising technology fairs. In 1999, the first high-tech fair was held in Shenzhen by the Shenzhen municipal government and was regarded as a "turning point", as described by a senior manager in a venture capital firm in Shenzhen, as Shenzhen local companies like Tencent agreed the

first venture investment with linkages built during the fair:

> *...The high-tech fair can be a turning point for Shenzhen's entrepreneurship and innovation…. In the first high-tech fair, for the first time we brought in venture capitalists and mingled them with entrepreneurs in China officially and systematically…. Many companies who later became famous attracted their first investment [during] this fair, such as Tencent…. (Q5.8.4)*

The weak ties would then serve as a basis for the second enabling condition – transformation from weak to strong social ties.

5.9.2 Transformation from weak ties to strong ties

The formation of social ties alone does not translate into resource diversification. It is not until weak social ties are transformed into strong social ties, indicated by value co-creation activities such as co-founding start-ups, venture capital investments and business collaborations, that resource diversification can be made possible. From the data, it is found that there are mainly two types of strong tie transformation; the first one is the formation of a start-up's founding team from the weak ties formed through informal means. The CEO of an earphone start-up in Shenzhen described how he met his co-founder:

> *...I knew my co-founder actually from an alumni's experience-sharing seminar held by the local alumni association…. I was surprised to find out that he was also interested in the earphones and back in the US he was in an acoustics lab…. We almost very quickly reached consensus in creating our own earphone brand…. (Q5.8.5)*

The founding team formation through transforming the weak ties built in various activities is also evident in Silicon Valley, as the co-founder of a technology and industry news media company in Silicon Valley noted:

...Because of the atmosphere, you can always find like-minded people who are interested in founding a new company together with you in Stanford, when you participate in their various activities regarding technologies and entrepreneurships… (Q5.8.6)

Indeed, as is mentioned previously, the weak ties formed by Google's two co-founders via participating in university activities were ultimately transformed to strong ties when they co-developed the PageRank system and set up Google based on the algorithm. Similarly, DJI was founded in Shenzhen by transforming the weak social ties formed at the robotics contest into strong ties – co-developing the flight control systems. In both Google and DJI's cases, new technologies were developed, the companies were established, and ecosystem resources were diversified along their entrepreneurial processes.

The second type of strong tie transformation is the start-ups, business collaborations or investments initiated from formal activities and business relationships. These formal activities can be, for example, the high-tech fairs held in Shenzhen since 1999, which attracted entrepreneurs and SMEs to demonstrate their products and solutions, venture capitalists and other financial institutions to search for good projects, as well as companies looking for partners and complementary technologies. The fair has continuously helped all ecosystem actors to establish weak social ties and potentially transform them into strong ties by setting down investments and business collaborations afterwards. For instance, the founder of an electronics company in Shenzhen described how he got the first venture investment and subsequently decided to return to Shenzhen to establish his own company:

...I attended the first high-tech fair held in Shenzhen, in 1999. At that time, we were provided with free demonstration space and mingling opportunities with venture capitalists. After we successfully attracted investments, the governments also provided loans with no interest. That's why I moved back from the US... (Q5.8.7)

Formal business relationships in established companies could also serve as a basis for the

strong tie transformation to occur. The transformation can be, for example, an internal group specialising in a particular technology in an established company spins out as a whole and establishes a new company to further utilise the technology they develop. Recall that in Fairchild and Intel's entrepreneurial process in the 1960s, co-founders were colleagues in previous companies working on the same technologies – for Fairchild, the co-founders were research scientists in Shockley's company and some of the Fairchild co-founders then jointly created Intel based on the technologies they had long been developing at Fairchild. Strong tie transformation is prevalent today in Silicon Valley as well, as a co-founder of a media company focusing on entrepreneurship and investment news in Silicon Valley described to us:

> *…The big companies in Silicon Valley like Google, Facebook and Apple are like the military academy of entrepreneurs. Many internal groups [of these companies] focusing on specific technologies choose to jump out and set up their own companies as it is always more efficient to realise the ideas outside of these big corporations. I know some people who got into a strong group in Google and, along with the group leader, they started a new company…. (Q5.8.8)*

Weak tie formation and strong tie transformation provide necessary conditions for new resources to emerge and thrive but are not sufficient for resource diversification in the entrepreneurial ecosystems.

5.9.3 Modularised industries and new venture creation process

In addition to weak tie formation and strong tie transformation, it is also found that the modularised nature of the industries and the uniquely disintegrated new venture creation process in both Shenzhen and Silicon Valley ecosystems act as enabling conditions for resource diversification.

As Silicon Valley and Shenzhen ecosystems are both centred around the information and communications technology industry, the findings show that the nature of this industry, which

is highly disintegrated and modularised, indeed serves as a key enabling condition for new resources to emerge and thrive within the ecosystems. This is because, when the industry is highly disintegrated and modularised, start-ups are more likely to find a niche position to enter. Technology and market isolations as disadvantages for start-ups and/or second movers (Lieberman and Montgomery, 1988, 1998) in this sense will be greatly diminished when they essentially compete with incumbents in different segments. A director of an Electronic Design Automation (EDA) company in Silicon Valley described their successful entry into the market and how this relates to the success of Silicon Valley's entrepreneurial ecosystem:

> *We are [a] fairly small company, but we can still make a difference. This is one of the reasons why Silicon Valley is so successful: companies focus on specialised and niche areas or segments… you can always find your position as a newcomer in the industry and the industry environment is friendly for new players to emerge…. For example, we are the most influential company in the EDA segment within the electronics industry… (Q5.8.9)*

The modularised (see also Baldwin and Clark, 2000) and highly disintegrated nature of the ICT industry also provides the opportunity for the ecosystem to have a comprehensive value chain for start-ups to successfully prototype their ideas and prevail in the market through rapid trial and error. The reason is twofold. On the one hand, a comprehensive value chain agglomerated in the same ecosystem enables start-ups with limited resources to access key components more conveniently. On the other hand, the comprehensive value chain often includes small and medium suppliers other than incumbent ones, which reduces the power asymmetry between upstream suppliers and downstream start-ups. For example, a smartphone start-up in Shenzhen can access key component suppliers within the ecosystem easily, and, most importantly, a wide range of choice from high-end suppliers to low-end suppliers is often available for most components in Shenzhen. This is crucial for the start-ups to emerge in the market because, as start-ups, their organisational status often does not help them source from internationally top-tier suppliers due to their unestablished reputation and low order quantities. In this sense, accessible and comprehensive local value chains could precipitate the emergence of these start-

ups, with potential new technologies, new business models and new organisational forms and/or routines being created and popularised, as a senior manager of an electronics company described the accessibility of Shenzhen's value chain for electronics:

> *…Shenzhen has a comprehensive value chain for hardware production. In every step of the production, there are numerous companies…. For example, there are many small electronics companies who provide services and components that big companies won't do…. You can easily source components from a radius of 15 kilometres… (Q5.8.10)*

Similar to the facilitating effects of a modularised and highly disintegrated industry architecture for new companies and new species to emerge, it is found that the modularisation of the new venture creation process also acts as a critical enabling condition for start-ups to emerge, with the potentiality to create new resources for the ecosystems. In both Silicon Valley and Shenzhen, it is found that the whole venture creation process is highly disintegrated, with every activity along the process being occupied by numerous intermediary companies, as the founder of a robotics start-up in Silicon Valley observed:

> *…The entrepreneurial environment and atmosphere is mature here in Silicon Valley…Because it is very mature with long historical accumulation of new venture creation, so there is sufficient support along the whole process of new venture creation. Support like legal services, human resources, financial management…. These services could be provided by the ecosystem in Silicon Valley and you can find these services easily…. (Q5.8.11)*

The modularised and specialised venture creation process is critical for new species in the ecosystem to emerge because start-ups or entrepreneurs do not normally possess sufficient resources to commercialise their ideas and technologies and set up organisations without accessing ecosystem resources. When the ecosystems offer specialised and disintegrated intermediary players such as incubators, accelerators, legal and human resource service companies for start-ups, as well as different funding institutions focusing on different stages of

new ventures, the barrier to commercialising new technologies, implementing new business models and trying out new organisational forms is significantly lowered due to the increased accessibility of supporting resources along the new venture creation process other than physically delivering products. When the modularised and specialised venture creation process is present, start-ups can be created more efficiently, increasing the likelihood of the emergence of new resources in the ecosystems. This is akin to a flow line production of commodities, with each step standardised and modularised, as the director of a local consulting company in Shenzhen noted:

> *…This is what you call [an] ecosystem…. There are many specialised and professional service providers for new venture creations. For example, accounting, finance, legal services and human resource services, etc. This is what the ecosystem can offer for the start-up to focus on developing products. Also, Shenzhen has comprehensive value chains, with a variety of production-related service providers, such as moulding, testing, etc.… (Q5.8.12)*

5.9.4 Moderate institutional environment and appropriability regimes

If the first three conditions are pertinent to the material and social attributes of an entrepreneurial ecosystem (Spigel, 2017), there remains a final condition relevant to both material and cultural attributes. For the ecosystem resource to diversify, a final condition – moderate institutional environment and appropriability regime – is essential. Certainly, a weak institutional environment and appropriability regime will hamper value creation and capture of new technologies from the firm's perspective (Teece, 1986). Accordingly, companies in an ecosystem with a strong institutional environment and appropriability regime will be more likely to capture value from their own innovations, at least in the short run. However, from the data, it is found that a moderate institutional environment and appropriability regime could be more viable for the ecosystem resources to diversify.

The moderate institutional environment and appropriability regime in both Shenzhen and

Silicon Valley are reflected in two different attributes – cultural and material. Culturally, the two regions are used to idea sharing and mutual learning and they put more emphasis on value co-creation rather than single-minded value capture for themselves. For example, the Shanzhai companies in Shenzhen were willing to share information, including new product designs, new market channels, and new component suppliers, etc., even with fellow Shanzhai OEMs who essentially would compete with each other in various markets. However, these collaborative efforts eventually made Shanzhai OEMs, collectively, very successful in the Chinese rural markets, as well as in African markets, because of the aggregated capabilities and resources. The legacy left by Shanzhai companies has not faded away in Shenzhen, where many companies follow a similar approach to pave their way globally and compete with global brands, as a senior manager of a smartphone company in Shenzhen noted:

> *Shenzhen companies do not have a tradition of secrecy…. The Shanzhai companies were highly collaborative…. When a Shanzhai OEM acquired any information regarding the market, they would share [it] with other Shanzhai companies, not only upstream suppliers but also other Shanzhai OEMs…. Together like this, Shanzhai mobile phones were very successful in African markets… (Q5.8.13)*

This idea-sharing and mutual-learning tradition is salient in Silicon Valley, as the co-founder of a venture capital firm who was the founder of a PC component provider noted:

> *They [companies and individuals] are willing to share…. When they invent something, profiting from it does not come to the first place. I remember in 1985 when I first came here all the PC=related knowledge was free and shared across the Bay Area. You can use other people's knowledge…. This tends to encourage people to do more. (Q5.8.14)*

The other key aspect is the material attribute of the ecosystems. Both Shenzhen and Silicon Valley have reasonably loose institutional environments and government policies related to intellectual properties. As a professor at Tsinghua University Shenzhen Campus pointed out,

Shenzhen's government believes in a trial and error approach towards innovations that may be violating existing governing policies or guidelines but could otherwise bring social benefits:

> *Our government is relatively tolerant towards innovations that could potentially bring some problems but are beneficial for the society… taking the example of the sharing bikes in China…. In Shenzhen you can see them everywhere…. They [the government officials] always hold an experimental mind-set and relaxed the policies towards these new things…. I believe this is an important reason for having a vibrant entrepreneurial ecosystem with new things coming up continuously here in Shenzhen... (Q5.8.15)*

In Silicon Valley, the legal system is also favourable for start-ups. The non-compete clause in contract law enables employees in Silicon Valley to flow to other companies with fewer constraints. In this way, knowledge embedded with them spills over to other companies in the ecosystem more effectively and efficiently, thus increasing the possibility of the emergence of new resources in the ecosystem, as the co-founder of a technology and industry news media in Silicon Valley told us:

> *…Another factor is the legal aspect. The legal system in California is reasonably relaxed towards companies and start-ups. For example, there is no non-compete clause in the contract law, which means the law does not forbid one from hopping to another company that is doing the same business. This has made the fluidity of talents in the Valley very high and increased the knowledge flow within the ecosystem which often comes with the people…. (Q5.8.16)*

5.10 Summary

Answering to the first sub research question 'what are the dimensions for entrepreneurial ecosystem health', Chapter 5 identifies six dimensions: ecosystem resources, entrepreneurial process, ecosystem performance, ecosystem robustness, ecosystem adaptation, and enabling conditions for resource dynamisms.

6. Resource Dynamisms in Entrepreneurial Ecosystems

> *[T]he predominant large-scale econometric studies have been essential to understanding the determinants and variations of entrepreneurship in certain regions. However, such studies have limitations, especially in uncovering reciprocity…. Since the entrepreneurial process in regions is dynamic, it occurs over time, involves various agents and various dimensions of the local, meso and macro environment, it is imperative to focus on the interplay, the potentially reinforcing links and relations.* Müller (2016, p.16)

6.1 Introduction

Chapter 5 shed light on the key dimensions of entrepreneurial ecosystem health. In particular, four resource dynamisms within entrepreneurial ecosystems were identified. Although the resource dynamisms are at the ecosystem level, they are nevertheless aggregated outcomes of resource-accessing behaviours in the individual entrepreneurial activities. Hence, this chapter aims at answering the second sub research question 'How do individual entrepreneurial activities contribute to collective entrepreneurial ecosystem health', by showing how individual resource-accessing behaviours contribute to ecosystem-level resource dynamisms.

Table 6-1 lists all the case companies' resource-accessing behaviours – resource acquisition, resource exploitation and resource feedback – for different ecosystem resources along their entrepreneurial processes. In particular, the specific behaviours that contribute to different resource dynamisms at the ecosystem level are marked with different numbers of stars. It is found that different resource-accessing behaviours at the individual level actually contribute to different types of resource dynamisms in the ecosystems. Furthermore, as the entrepreneurial ecosystems evolve from the emerging phase through the growing phase to the mature phase, the extent of certain resource dynamisms changes as well.

Table 6–1 Individual entrepreneurial processes in relation to their use of entrepreneurial ecosystem resources

*Implications to EE resources: * resource replenishment in EE; ** resource recycling in EE; *** resource exit in EE; **** resource diversification in EE*

EE	*Case companies*	*Resource dynamics in individual entrepreneurial processes*			*Types of resource*
		Resource acquisition	*Resource exploitation*	*Resource feedback*	
Silicon Valley	Fairchild	Technologies embedded in the Traitors Eight during their work in Shockley **	Invented planar process to manufacture silicon components ****	The first generation of silicon production was replaced by the planar process in most semiconductors companies in the industry ***	Technologies and Production resources
		The Traitors Eight were hired by Shockley from the East Coast *	N/A	Traitors Eight as well as the other early employees left Fairchild and entered different areas for new venture creations	Human resources
		Linkages to East Coast bankers by Kleiner's family	N/A	Fairchild as the WestPoint of the semiconductors industry **	Social capital
		N/A	The first venture capital fund ever in the Bay area; it paved a new approach of investment – technology could win shares for the co-founders. ****	First spin-off, Rheem, from Fairchild ** Amelco was founded by three of the Traitors Eight ** Intel – spin-off from Fairchild **	Organisations (including organisational forms, routines, and practices)
		Kleiner's letter to his family's fund manager was seen by Rock	In a meeting arranged with Rock, the Traitors Eight persuaded him to invest, in exchange for shares. First venture capital investment ****	N/A	Financial capital
		N/A	N/A	N/A	Intermediaries
		N/A	First contract accessing parent company in the east as a shareholder of IBM	N/A	Market resources
	Intel	Direction of chip R&D set by Intel founders in Fairchild **	First CPU developed by Intel ****	1103 DRAM adopted by most PC companies ***	Technologies and Production resources
		Gathered co-founders in Fairchild – Groove, Moore and Noyce ** Employees from Stanford University including Hoff who later designed CPU *	N/A	N/A	Human resources

	Linkages with Rock in Fairchild and Traitors Eight	N/A	N/A	Social capital
	N/A	N/A	Distributing shares to employees, imitated by other SV companies **** KPCB founded by Kleiner **** Don Valentine founded Sequoia Capital ****	Organisations (including organisational forms, routines, and practices)
	Investment from other Traitors Eight * Conducted several rounds of financing with Rock's help*	N/A	N/A	Financial capital
	N/A	N/A	N/A	Intermediaries
	N/A	N/A	N/A	Market resources
Apple	Jobs attended computer science courses at Stanford University	Jobs got DRAM from Intel after writing a letter Former Atari employee helped design the main board Body of Apple II designed by a Homebrew Club member Idea of GUI conceived after visiting Xerox SV **** First mouse was designed by a local company recruited by Apple ****	The GUI and mouse style replaced IBM's traditional PC with command lines, etc. ***	Technologies and Production resources
	Wozniak's family moved to SV as father worked as an engineer at Lockheed Martin* Founder team built up attracted former Atari employees ** Wozniak knew Jobs and other early employees in high school	Utilised linkages in Atari and Homebrew Club to hire new employees Don introduced Markkula, who was a director of Intel, to join Apple as CEO Markkula later invited former Fairchild employee Mike Scott to be CEO	N/A	Human resources
	N/A	Connection to Xerox research centre established by Raskin, a former Atari employee, for Jobs to visit and be further inspired by Xerox's ideas ****	N/A	Social capital
	Jobs became familiar with product design	N/A	Jobs established NEXT with some of the key	Organisations

	working at Atari **		Apple employees **	(including organisational forms, routines and practices)
	Atari CEO Bushnell suggested Jobs approach Don Valentine for investment * Markkula persuaded Rock to invest in Apple * Xerox involved in second-round financing *	N/A	N/A	Financial capital
	N/A	Homebrew Club was established and Jobs and Wozniak were early members to gather feedback and ideas on products ****	N/A	Intermediaries
	N/A	Demonstration in Homebrew Club attracts local computer shop who made the first order	N/A	Market resources
Google	Brin and Page borrowed from several departments at Stanford to run their project	Page conceived the idea of working out the links between webpages ****	PageRank beat the traditional Yahoo! etc.'s simple linkages between webpages as the industry standard *** Auction-based advertising invented by Google and became standard for future search engines ***	Technologies and Production resources
	Brin joined Stanford University for computer science and knew Page, who also joined the same department * Recruiting from fresh Stanford graduates as a tradition *	N/A	Several early members of the team left for further new venture creations**	Human resources
	N/A	Connected with a Stanford alumni, who developed the then popular search engine **** Connected with AOL with the help of KPCB for collaboration and investment ****	N/A	Social capital
	N/A	N/A	Brian Lent, one of the early members, established Medio Systems after leaving the project **	Organisations (including organisational forms,

				routines and practices)
	Larry's superior Garcia-Molina got money from a project for Brin and Page * Earliest investors introduced by Stanford professor *	Getting privileged low share exchanges for huge investment from KPCB and Sequoia, creating a new way of bargaining with leading technologies****	An unconventional way of IPO, open to all investors, employing a local investment bank, against the traditional Wall Street approach ****	Financial capital
	N/A	N/A	N/A	Intermediaries
	N/A	N/A	N/A	Market resources
Tesla				
	Tarpenning and Eberhardt had experience with lithium batteries **	Battery factory in Thailand, sourcing components from major European car makers X.com established by Musk created the first online banking in collaboration with Barclays and FDIC **** Developed battery management system, the core of Tesla ****	Model S served as the model for pure electric cars and competed with hybrid and traditional vehicles ***	Technologies and Production resources
	Staubel attended Stanford University * Musk moved to SV for an internship in a games company * Musk's brother was persuaded to move to SV *	N/A	A few key employees such as Eberhardt and Tarpenning left the company as the Roadster project was not going well **	Human resources
	In a talk given by Musk in Stanford, Eberhard and Tarpenning felt Musk would be a potential co-founder in Tesla	Musk helped built connections with major VCs such as Draper, VantagePoint and Larry Page as individual investors ****	N/A	Social capital
	N/A	N/A	N/A	Organisations (including organisational forms, routines, and practices)
	Musk profited from selling Zip 2 * Musk invested in and joined Tesla * Straubel joined Tesla and attracted more Stanford graduates as an alumnus ** Daimler acquired a 10% share in Tesla	N/A	N/A	Financial capital
	N/A	Demonstration in the Pebble Beach	N/A	Intermediaries

			Concours d'Elegance car demonstration		
		N/A	Daimler started to purchase battery systems from Tesla	N/A	Market resources
Shenzhen	Huawei	During Ren's work at a state-owned electronics company he learnt about the switching technologies in telephones **	Successfully released H08**** Launch of CDMA 1X marked that Huawei had obtained equal capability as international brands in telecommunications equipment ****	N/A	Technologies and Production resources
		Following an open-door policy and economic reform, Shenzhen attracted a lot of talents from the mainland * Ren joined a state-owned company in Shenzhen * Massive hiring from HZUST and Tsinghua in the early Huawei *	N/A	Ex-Huawei employees joining other start-ups and helping their success, such as Tencent **	Human resources
		N/A	Connected to China Merchants after Premier's visits following success of H08 ****	Ex-Huawei employees set up Huawei club to connect all previous Huawei employees ****	Social capital
		N/A	Following the reform of share-holding companies in China, Huawei started to distribute shares to its employees ****	Huawei began to encourage senior employees to start their own companies ****	Organisations (including organisational forms, routines, and practices)
		Raised first investment in the agent businesses *	N/A	Huawei's early employees served as the first individual investors in Shenzhen **	Financial capital
		N/A	N/A	Ren suggested to the Chinese government that it should protect local telecommunication companies ****	Intermediaries
		Ren was introduced by a local agent to sell Hong Kong's switching systems	Open up rural market for telephone switching systems Won contract from Shenzhen China Unicom and Shenzhen Post Office	N/A	Market resources
	Tencent	Ma and his co-founders took computer-related courses in Shenzhen University Purchased components from Huaqiangbei	Ma developed a unique sense of product design during his work in RunXun and management of FidoNet	QQ instant messaging severely affected the short message service on the mobile phones from state-owned mobile operators, forcing	Technologies and Production resources

	to assemble more computers for software development	QICQ was developed, first customised instant messaging software in China ****	them to cooperate with companies like Tencent ***	
	Ma arrived in Shenzhen with his family * Gathered co-founders in Shenzhen who were as interested in the Internet as he was * Attracted many FidoNet users as first software developers from all around China * Tencent attracted employees previously at Huawei **	N/A	Tencent employees further started a few famous start-ups**	Human resources
	Ma joined RunXun and learnt the paging centre business in the company Ma started to manage FidoNet and got to know many later renowned Internet giants	N/A	N/A	Social capital
	N/A	N/A	VC industry rose in China thanks to some of the initial success funded by VCs such as Tencent ****	Organisations (including organisational forms, routines, and practices)
	IDG and Li Zekai from Hong Kong invested in Tencent *	N/A	N/A	Financial capital
	N/A	Attended the high-tech fair held in Shenzhen and attracted attention from the newly rising VCs in China ****	Tencent supported further new venture creation both by its own employees and outside innovations **	Intermediaries
	N/A	Won first order from Shenzhen telecommunications through one of the co-founders' personal linkages Started collaboration with China Unicom Shenzhen	N/A	Market resources
DJI	Utilising the experiences of Prof Li's first company, Googol, and also the course project Wang had done at HKUST **	DJI's core technology flight control system was developed **** Utilised smartphone apps to provide better experiences	Shanzhai-era component suppliers and manufacturing service providers declined but some upgraded to be able to support DJI ***	Technologies and Production resources
	Prof Li's lab established in HKUST attracted talents from mainland China to	N/A	Some of the early founders left and joined other drone companies **	Human resources

study automation and robotics * Tao Wang and his family moved to Shenzhen *			
N/A	N/A	N/A	Social capital
N/A	N/A	Three co-founders left and established their own companies in different areas of flight control and drones **	Organisations (including organisational forms, routines, and practices)
Prof Li and HKUST provided first funding * Individual investor Qun Zhang provided funding *	N/A	N/A	Financial capital
N/A	Nanshan government provided support	Sponsored Robotics contest every year to attract robotics talents **** Established Songshanhu Robotics Industrial Park as an incubator to nurture more robotics start-ups ****	Intermediaries
N/A	N/A	N/A	Market resources

6.2 Resource acquisition and implications for ecosystem resources

This section zooms into the resource acquisition activities illustrated in Table 6-1 and highlights their implications for ecosystem resources, as well as the main activity enablers as evidenced in the cases, which are compiled in Table 6-2.

Table 6–2 Resource acquisitions and implications for ecosystem resources

Companies	Resource acquisition activities	Implications for ecosystem resources	Activity enablers (evidence from cases)
Fairchild	Technologies embedded in the Traitors Eight during their work in Shockley brought to Fairchild	Resource recycling	Rebellious and free spirits; entrepreneurial culture
	The Traitors Eight were hired by Shockley from the East Coast	Resource replenishment	N/A
	Linkages to East Coast bankers by Kleiner's family	N/A	N/A
Intel	Kleiner's letter to his family's fund manager was seen by Rock	N/A	N/A
	Direction of chip R&D set by Intel founders in Fairchild	Resource recycling	N/A
	Gathered co-founders in Fairchild – Groove, Moore and Noyce Employees from Stanford University including Hoff who later designed CPU	Resource replenishment and recycling	Divergence with East Coast parent company's culture; rebellious and free spirits; entrepreneurial culture
	Linkages with Rock in Fairchild and Traitors Eight	N/A	N/A
	Investment from other Traitors Eight Conducted several rounds of financing with Rock's help	Resource replenishment and recycling	Entrepreneurial culture; supportive private capital market
Apple	Jobs attended computer science courses in Stanford University	N/A	N/A
	Wozniak's family moved to SV as father worked as an engineer at Lockheed Martin Founder team built up attracted former Atari employees Wozniak knew Jobs and other early employees in high school	Resource replenishment and recycling	Infrastructure; entrepreneurial culture
	Jobs became familiar with product design working at Atari	Resource recycling	N/A
	Atari CEO Bushnell suggested Jobs approach Don Valentine for investment Markkula persuaded Rock to invest in Apple Xerox involved in second-round financing	Resource replenishment	Supportive private capital market; entrepreneurial culture
Google	Brin and Page borrowed from several departments at Stanford to run their project	N/A	N/A
	Brin joined Stanford University for computer science and knew Page, who also joined the same department Recruiting from fresh Stanford graduates as a tradition	Resource replenishment	Attracted by Stanford education; infrastructure
	Page' superior Garcia-Molina got money	Resource replenishment	Able to source funding from outside of

	from a project for Brin and Page Earliest investors introduced by Stanford professor		universities; supportive private capital market
Tesla	Tarpenning and Eberhardt had experience with Lithium batteries	Resource recycling	Tarpenning and Eberhardt stayed in Silicon Valley for funding and talents; supportive private capital market and entrepreneurial culture
	Straubel attended Stanford University Musk moved to SV for an internship in a games company Musk's brother was persuaded to move to SV	Resource replenishment	Infrastructure, university and education system; entrepreneurial culture and mind-sets
	After attending a talk given by Musk in Stanford, Eberhard and Tarpenning felt Musk would be a potential co-founder in Tesla	N/A	N/A
	Musk profited from selling Zip 2 Musk invested in and joined Tesla Straubel joined Tesla and attracted more Stanford graduates as an alumnus Daimler acquired a 10% share of Tesla	Resource replenishment and recycling	Supportive private capital market and entrepreneurial culture in re-investing in local start-ups.
Huawei	During Ren's work in a state-owned electronics company he learnt about the switching technologies in telephones and started the agent business	Resource recycling	Entrepreneurial culture and risk-taking mind-sets
	Following the open-door policy and economic reform, Shenzhen attracted a lot of talents from the mainland Ren joined a state-owned company in Shenzhen Massive hiring from HZUST and Tsinghua in the early Huawei	Resource replenishment and recycling	N/A
	Raised first investment in the agent businesses	Resource replenishment	Supportive private capital market
	Ren was introduced by a local agent to sell Hong Kong's switching systems	N/A	N/A
Tencent	Ma and his co-founders took computer-related courses at Shenzhen University Purchased components from Huaqiangbei to assemble more computers for software developing	N/A	N/A
	Ma arrived in Shenzhen with his family Gathered co-founders in Shenzhen who were interested in the Internet just as he was Attracted many FidoNet users as first software developers from all around China Tencent attracted employees previously at Huawei	Resource replenishment and recycling	Entrepreneurial culture to attract programmers to join the company
	Ma joined RunXun and learnt the paging centre business in the company Ma started to manage FidoNet and got to know many later renowned Internet giants	N/A	N/A
	IDG and Li Zekai from Hong Kong invested in Tencent	Resource replenishment	Developing venture capitalists in Shenzhen, supportive private capital market
DJI	Utilising the experiences of Prof Li's first company, Googol, and also the course project Wang had done at HKUST	N/A	N/A
	Prof Li's lab established in HKUST attracted	Resource replenishment	University education, attractive

talents from mainland China to study automation and robotics Wang and his family moved to Shenzhen		infrastructure
Prof Li and HKUST provided first funding Individual investor Qun Zhang provided funding	Resource replenishment	Supportive private (investors like Qun) and public (grant from university) capital market.

From Table 6-2, it can be seen that resource acquisition behaviours in the individual level will contribute to the resource replenishment and recycling in the ecosystem level. These mainly involve financial resources and human resources as well as the social capital and technology resources embedded with them. For example, when Tencent managed to settle its first venture capital investments from Hong Kong and other international investors, financial resources were replenished in the Shenzhen entrepreneurial ecosystem; when the 'Traitors Eight' decided to establish Fairchild to pursue their ambitions in the semiconductor industry and the subsequent spin-off of Intel by two of their number, "which attracted investments by the other members as well as their friends in the semiconductor industry, both financial resources and human resources as well as the social capital embedded were recycled in the Silicon Valley ecosystem. In this sense, the following proposition can be derived:

P1a. The extent of resource acquisition behaviours in individual entrepreneurial processes will increase the extent of resource replenishment and resource recycling in entrepreneurial ecosystems.

Although, collectively, resource acquisition behaviours can increase the level of resource replenishment and recycling in entrepreneurial ecosystems, there are conditions facilitating such linkages. It is found that the conditions for resource replenishment and recycling that have been shown in Chapter 6 serve as moderators for the relationships between resource acquisition in the individual level and the resource dynamisms in the ecosystem level. Despite the fact that resource acquisition can take place anytime when entrepreneurs try to gather resources from the ecosystems, as can be seen in Table 6-2, not all of them lead to resource replenishment or recycling for ecosystem resources. In other words, the key moderators have precipitated the ecosystem-level resource replenishment and recycling resulting from resource acquisition in individual entrepreneurial processes.

For example, when Tencent first decided to accept venture capital investments, the developing venture capitalist industry guided by the Shenzhen government enabled Tencent to obtain financial investments from an investor in Hong Kong. These investments replenished the Shenzhen entrepreneurial ecosystem with financial resources. In the meantime, the growing awareness of entrepreneurship and entrepreneurial mind-sets in Shenzhen also helped Tencent in its early days as a start-up to hire top programmers who had previously worked in Huawei, which resulted in human resource recycling at the ecosystem level. Due to the liberated private capital market, many former Huawei employees who left Huawei with a fortune started to invest in Shenzhen's local start-ups, being the first individual investors, which indicates the moderating effect of supportive private capital market on the relationship between ecosystem-level resource recycling and individual-level resource acquisition. Attractive infrastructure like university education also acts as a key moderator for strengthening the ecosystem-level resource replenishment resulting from resource acquisition activities in the entrepreneurial process as university graduates establish their own companies – like Google in Silicon Valley and DJI in Shenzhen. Also, for these university graduates, joining a local start-up became a prevalent choice because of the open-minded and entrepreneurial culture, as in the case of Google hiring Stanford graduates and DJI being composed of HKUST students. This indicates the moderating effect of entrepreneurial culture on the relationship between resource acquisition and resource recycling in the ecosystem. Hence, the following proposition can be derived:

P1b. Attractive living conditions and infrastructure, open-minded and eclectic culture, and supportive public/private capital market will strengthen the relationship between resource acquisition behaviours in individual entrepreneurial processes and resource replenishment and recycling in entrepreneurial ecosystems.

6.3 Resource exploitation and implications for ecosystem resources

This section zooms into the resource exploitation activities illustrated in Table 6-1 and

highlights their implications for ecosystem resources, as well as the main activity enablers as evidenced in the cases, which are compiled in Table 6-3.

Table 6–3 Resource exploitation and implications for ecosystem resources

Companies	Resource exploitation activities	Implications for ecosystem resources	Activity enablers (evidence from cases)
Fairchild	Invented planar process to manufacture silicon components	Resource diversification	N/A
	The first venture capital fund ever in the Bay Area and paved a new approach of investment – technology that could win shares for the co-founders	Resource diversification	Network with Rock and social capitals of the Traitors Eight: weak tie formation and strong tie transformation
	In a meeting arranged with Rock, the Traitors Eight persuaded him to invest, in exchange for shares. First venture capital investment	Resource diversification	Network with Rock and social capitals of the Traitors Eight: weak tie formation and strong tie transformation
	First contract accessing parent company in the east as a shareholder of IBM	N/A	N/A
Intel	First CPU developed by Intel	Resource diversification	Intel co-founders were able to bring the technologies as well as the roadmap to the new company, Intel: moderate institutional environment and appropriability regimes.
Apple	Jobs got DRAM from Intel after writing a letter Former Atari employee helped design the main board Body of Apple II designed by a Homebrew Club member Idea of GUI conceived after visiting Xerox SV First mouse was designed by a local company recruited by Apple	Resource diversification	Strong tie transformation of co-founders in sourcing components and technologies; Technology clubs where weak time can be formed and transformed into strong ties subsequently; Idea sharing and open to mutual learning: moderate institutional environments and appropriability regimes.
	Utilised linkages in Atari and Homebrew Club to hire new employees Don introduced Markkula, who was a director of Intel, to join Apple as CEO Markkula later invited former Fairchild employee Mike Scott to be CEO	N/A	N/A
	Connection to Xerox research centre for Jobs to visit and to be inspired by Xerox's ideas established by Raskin, a former Atari employee	Resource diversification	Strong tie transformation of co-founders in acquiring talents
	Homebrew Club was established and Jobs and Wozniak were early members to gather feedback and ideas on products	Resource diversification	Technology clubs where weak ties can be formed and transformed into strong ties subsequently;
	Demonstration in Homebrew Club attracts local computer shop who made the first order	N/A	N/A
Google	Page conceived the idea of working out the links between webpages	Resource diversification	N/A
	Connected with a Stanford Alumni, who developed the then popular search engine Connected with AOL with the help of KPCB for collaboration and investment	Resource diversification	Weak tie formation through universities and venture capitalists; subsequent strong tie transformation while collaborating and investing.
	Getting privileged low share exchanges for huge investment from KPCB and Sequoia, creating a new way of bargaining with leading	Resource diversification	Modularised venture creation processes to leverage dynamics between investors.

	technologies		
Tesla	Battery factory in Thailand, sourcing components from major European car makers X.com established by Musk created the first online banking in collaboration with Barclays and FDIC Developed battery management system, the core of Tesla	Resource diversification	Modularised industries to leverage division of labour and specialise.
	Musk helped built connections with major VCs such as Draper, VantagePoint and Larry Page as individual investors	Resource diversification	Weak tie formation in previous start-up experiences and strong tie formation in subsequent new venture creation activity
	Demonstration in the Pebble Beach Concours d'Elegance car demonstration	N/A	N/A
	Daimler started to purchase battery systems from Tesla	N/A	N/A
Huawei	Successfully released H08 Launch of CDMA 1X marked that Huawei had gained equal capability as international brands in telecommunications equipment	Resource diversification	Modularised industry to leverage manufacturing capabilities
	Connected to China Merchants after Premier's visits following success of H08	Resource diversification	Indirect support from central government as Premier's political impacts on state-owned banks: moderate institutional environment
	Following the reform of share-holding companies in China, Huawei started to distribute shares to its employees	Resource diversification	Moderate institutional environment and appropriability regimes – reformation of share-holding-related laws in China opening new ways of distributing shares to employees.
	Open up rural market for telephone switching systems Won contract from Shenzhen China Unicom and Shenzhen Post Office	N/A	N/A
Tencent	Ma developed a unique sense of product design during his work in RunXun and management of FidoNet QICQ was developed, first customised instant messaging software in China	Resource diversification	N/A
	Attending the high-tech fair held in Shenzhen and attracted attention from the newly rising VCs in China	Resource diversification	Weak tie formation in technology fairs, strong tie transformation from weak ties
	Won first order from Shenzhen telecommunications through one of the co-founders' personal linkages Started collaboration with China Unicom Shenzhen	N/A	N/A
DJI	DJI's core technology flight control system was developed Utilised smartphone apps to provide better experiences	Resource diversification	Modularised industries to leverage specialised components providers and manufacturing capabilities while specialising in software
	Nanshan government provided support	N/A	N/A

From Table 6-3, it can be seen that resource exploitation behaviours in the individual entrepreneurial process could contribute to the resource diversification in entrepreneurial ecosystems. These involve resources such as technologies, new business models and practices, as well as new organisational forms and intermediaries. For example, when Fairchild's co-

founders were seeking investments for their processor technologies, a new investment model for start-ups was born; that is, entrepreneurs could exchange their technologies for shares in the companies they set up, with external investment from individuals and institutions. Subsequently, financial institutions that focused exclusively on venture investment, which are known as venture capitalists, emerged in Silicon Valley and spread to the rest of the world. In Shenzhen, following the reform of shareholder laws and financial regulations, Huawei started to distribute shares to its employees and also encourage them to purchase the company's internal stock rights. This practice not only enhanced the morale of Huawei's employees, but also collected sufficient funding for Huawei to further invest in R&D in order to capture the telecommunications equipment market. Although it is not new for Silicon Valley companies, this practice was imitated by many subsequent start-ups in Shenzhen, which has helped local start-ups to attract the best talents. As is shown in Chapter 5, these resources are not only novel for the entrepreneurial ecosystems; they also serve as disruptive resources that alter the method of new venture creation and often resolve bottlenecks in the new venture creation process. In this sense, the following proposition can be derived:

P2a: The extent of resource exploitation behaviours in individual entrepreneurial processes will increase the extent of resource diversification in entrepreneurial ecosystems.

Although, collectively, resource exploitation behaviours can increase the level of resource diversification in entrepreneurial ecosystems, there are conditions to facilitate such linkages. It is found that the conditions for resource diversification, which are formation of weak social ties, transformation from weak ties to strong ties, modularised industries and new venture creation process, as well as moderate institutional environment and appropriability regimes, as we have shown in Chapter 5, serve as moderators for the relationships between resource exploitation behaviours in the individual level and the resource diversification in the ecosystem level. Despite the fact that resource exploitation behaviours can take place anytime when entrepreneurs utilise the resources they have acquired from the ecosystem, as is seen in Table 6-3, not all of them lead to the creation of novel resources. In other words, these key moderators

have precipitated the ecosystem-level resource diversification resulting from resource exploitation in individual entrepreneurial processes.

For example, before Apple released its first personal computer, Jobs and Wozniak had joined the Homebrew Club, a local electronics technology club. In this club, Apple's two co-founders for the first time demonstrated their prototypes and received considerable attention. During their social and technology demonstration activities, weak social ties were formed. In fact, not long after their first demonstration, a local computer seller approached them and ordered the first batch of Apple's computers. Additionally, when Apple was designing its second-generation personal computer, Apple II, many of the then engineers and designers were recruited from the club, as a result of the transformation from weak ties to strong ties. These two conditions enabled Apple to deliver its earliest technologies in personal computers. As another example, when Tencent demonstrated its software for the first time in the high-tech fair organised in Shenzhen by the government, they got the opportunity to pitch their products and visions to many investors at the fair, which ultimately led to the first venture capital investment in the company. This investment enabled QICQ to be upgraded into the completely localised QQ, which dominated the Chinese market soon afterwards.

Modularised industries and new venture creation process can also catalyse the linkage between resource exploitation and resource diversification. For example, by leveraging Shenzhen's specialised players in manufacturing, electronic components and prototyping, DJI's founding team was able to focus exclusively in its early days on developing its drone flight control system, which has become the core technology held by the company. A modularised venture creation process may also facilitate resource diversification in the ecosystems through resource exploitation by start-ups. For example, Google successfully leveraged the dynamics between multiple investors in different stages of its entrepreneurial process and secured favourable deals in venture investments in the early stage, as well as in the later stage up until its initial public offering.

Moderate institutional environment and appropriability regimes could also positively influence

the linkage between resource exploitation by start-ups and resource diversification in the ecosystems. For example, Apple was able to conceive the idea of a graphical user interface and finally integrate it into Apple computers because of Xerox's generous opening of their labs to Apple employees. The shared mind-sets and resultant moderate appropriability regimes helped the resource exploitation behaviours (leveraging social network of their investors) of Apple turn into the creation of novel technological resources. Another example is Huawei's aforementioned novel practices of distributing its shares to key employees. This was enabled by the reform of shareholder regulations in China, as characterised by the moderate institutional environment, which is reasonably relaxed for companies to adopt flexible and often revolutionary practices.

Hence, the following proposition can be derived:

P2b: Formation of weak social ties, transformation from weak ties to strong ties, modularised industries and new venture creation processes, as well as moderate institutional environment and appropriability regimes, will strengthen the relationship between resource exploitation behaviours in individual entrepreneurial process and resource diversification in entrepreneurial ecosystems.

6.4 Resource feedback and implications for ecosystem resources

This section zooms into the resource feedback activities illustrated in Table 6-1 and highlights their implications for ecosystem resources, as well as the main activity enablers as evidenced in the cases, which are compiled in Table 6-4.

Table 6–4 Resource feedback and implications for ecosystem resources

Companies	Resource feedback activities	Implications for ecosystem resources	Activity enablers (evidence from cases)
Fairchild	The first generation of silicon production was replaced by planar process by most semiconductors companies in the industry	Resource exit	Market selection: facilitating technology substitution
	Traitors Eight as well as the other early employees left Fairchild and entered different	Resource recycling	Supportive private capital market; entrepreneurial culture

	areas for new venture creations		
	Fairchild as the WestPoint of the semiconductors industry	Resource recycling	Open-minded and entrepreneurial culture; industrial infrastructure building up
	First spin-off, Rheem, from Fairchild Amelco was founded by three of the Traitors Eight Intel – spin-off from Fairchild	Resource recycling, resource diversification	open-minded and entrepreneurial culture; formation of weak social ties in companies, transformation to strong ties when new opportunities/technologies emerged in the semiconductor industry; leveraging modularised industries to specialise in different sub-sectors.
Intel	1103 DRAM adopted by most PC companies	Resource exit	Market selection: facilitating technology substitution
	Distributing shares to employees, imitated by other SV companies KPCB founded by Kleiner Don Valentine founded Sequoia Capital	Resource diversification, resource recycling	N/A; supportive private capital market; entrepreneurial culture
Apple	The GUI and mouse style replaced IBM's traditional PC with command lines, etc.	Resource exit	Market selection: facilitating technology substitution
	Jobs established NEXT with some of the key Apple employees	Resource recycling	Supportive private capital market; entrepreneurial culture
Google	PageRank beat the traditional Yahoo! etc.'s simple linkages between webpages as the industry standard Auction-based advertising invented by Google and became standard for future search engines	Resource exit	Market selection: facilitating technology substitution
	Several early members of the team left for further new venture creations	Resource recycling	Entrepreneurial mind-sets; supportive private capital market
	Brian Lent, one of the early members, established Medio Systems after leaving the project	Resource recycling	Supportive private capital market; entrepreneurial culture
	An unconventional way of IPO, open to all investors, employing a local investment bank, against the traditional Wall Street approach	Resource diversification	Modularised venture creation process; leveraging dynamics and competitions between investment banks
Tesla	Model S served as the model for pure electric cars and competed with hybrid and traditional vehicles	Resource exit	Market selection: facilitating techno-industrial substitution
	A few key employees such as Eberhardt and Tarpenning left the company as the Roadster project was not going well	Resource recycling	N/A
Huawei	Ex-Huawei employees joining other start-ups and helping their success, such as Tencent	Resource recycling	Supportive public/private capital market; entrepreneurial culture
	Ex-Huawei employees set up Huawei club to connect all previous Huawei employees	Resource diversification	Creation of new intermediary organisations, facilitated by moderate institutional environment in Shenzhen and formation of weak social ties in Huawei
	Huawei began to encourage senior employees to start their own companies to commercialise technologies developed in the company both upstream and downstream of Huawei's businesses to complement its core products	Resource diversification	Moderate appropriability regimes, Huawei willing to trade off for technologies in order to control value chains; modularised industries to create opportunities for specialisation
	Huawei's early employees served as the first individual investors in Shenzhen	Resource recycling	Entrepreneurial culture and mind-sets; supportive private capital market
	Ren suggested to the Chinese government that it should protect local telecommunication companies	Resource diversification	New policy initiatives proposed by entrepreneurs; moderate institutional environment
Tencent	QQ instant messaging severely affected the short message service on the mobile phones from state-owned mobile operators, forcing them to	Resource exit	Market selection: facilitating technology substitution

	cooperate with companies like Tencent		
	Tencent employees further started a few famous start-ups	Resource recycling	Entrepreneurial mind-sets; supportive private capital market
	VC industry rose in China thanks to some of the initial success funded by VCs such as Tencent	Resource diversification	Moderate institutional environment: reform of shareholder regulations and allowing private capital to invest in new ventures
	Tencent supported further new venture creation both by its own employees and outside innovations	Resource recycling	Entrepreneurial mind-sets; supportive private capital market
	Shanzhai-era component suppliers and manufacturing service providers declined but some upgraded to be able to support DJI	Resource exit, resource recycling	Highly re-combinative industry architecture; Industrial infrastructure retaining upstream suppliers and downstream OEMs
DJI	Some of the early founders left and joined other emerging drone companies	Resource recycling	Entrepreneurial mind-sets
	The other three co-founders left and established their own companies in different areas of flight control and drones	Resource recycling	Entrepreneurial mind-sets; supportive private capital market
	Sponsored Robotics contest every year to attract robotics talents Established Songshanhu Robotics Industrial Park as an incubator to nurture more robotics start-ups	Resource diversification	New intermediary organisations and activities for weak tie formation and strong tie transformation, leading to diversification of resources

From Table 6-4, it can be seen that resource feedback behaviours in the individual entrepreneurial process could contribute to the resource recycling, exit and diversification in entrepreneurial ecosystems. These mainly involve production and technological resources, organisational resources such as new business practices, and intermediary resources. For example, Intel's spin-off from Fairchild is a resource feedback activity which leads to resource recycling in the ecosystem, as many former Fairchild engineers and developers joined Intel, including two of the Fairchild co-founders. Huawei's resource feedback activities towards the end of its entrepreneurial process include setting up a Huawei ex-employee club in support of their new venture creations. The birth of this club created a new species in the ecosystem and therefore diversified the ecosystem resources. Resource exit brought about by resource feedback activities is also salient in the cases. Fairchild's planar manufacturing process substituted the traditional production method of silicon-based processors. Similarly, Apple's graphical user interface also proved its superiority in the market. The legacies left by these companies at the end of their entrepreneurial processes contributed to the exit of obsolete resources in the ecosystems. In this sense, the following proposition can be derived:

P3a: The extent of resource feedback behaviours in individual entrepreneurial processes will increase the extent of resource recycling, exit and diversification in

entrepreneurial ecosystems.

Although, collectively, resource feedback behaviours can increase the level of resource recycling, exit and diversification in entrepreneurial ecosystems, there are conditions to facilitate such linkages. It is found that the conditions for resource recycling, exit and diversification, as is shown in Chapter 5, serve as moderators for the relationships between resource feedback behaviours in the individual level and the resource dynamisms in the ecosystem level. Despite the fact that resource feedback behaviours can take place anytime when start-ups release the resources they have acquired from the ecosystems due to their exit from the market for various reasons, as can be seen in Table 6-4, not all of them lead to resource dynamisms in the ecosystems. In other words, these moderators have precipitated the ecosystem-level resource dynamisms resulting from the resource feedback in individual entrepreneurial processes.

Similar to P2b, the four conditions also serve as moderators for the relationship between resource feedback activities in individual entrepreneurial processes and resource diversification in the ecosystems. For example, spin-offs of Fairchild resulted from identifying new opportunities in the semiconductor industries. This was enabled by the weak tie formation in Fairchild as most of the co-founders of these spin-offs were previous employed by Fairchild. By transforming the weak ties into strong ties, new ventures were created such as Rheem, AMD and Amelco. The modularised semiconductor industry also provided an opportunity for start-ups to identify niche positions and specialise. As another example, moderate institutional environment and appropriability regimes also enabled the resource diversification through Huawei's feedback to ecosystem resources such as new policy initiatives to promote local telecommunications companies and the ex-Huawei employee club in support of their start-ups. Hence, the following proposition can be derived:

P3b: Formation of weak social ties, transformation from weak ties to strong ties, modularised industries and new venture creation process, as well as moderate institutional environment and appropriability regimes, will strengthen the relationship

between resource feedback behaviours in individual entrepreneurial processes and resource diversification in entrepreneurial ecosystems.

It is also found that the two conditions – facilitating techno-industrial substitution and highly re-combinative industrial architecture – also serve as moderators in the linkage between resource feedback and resource exit in ecosystems. For example, due to Shenzhen's highly re-combinative industry architecture, indicated by its high embeddedness in the local and global value chains, the exit of some of the Shanzhai manufacturers from Shenzhen's ecosystem created spaces for the resilient ones to upgrade and serve incoming start-ups including DJI, who leveraged some of the Shanzhai suppliers extensively in the early days of product development. In terms of facilitating techno-industrial substitution, although Silicon Valley companies successfully developed technologies that prevailed in the market and facilitated the exit of obsolete technologies, the Shenzhen government proactively supported start-ups like DJI to help the upgrade and exit of obsolete and inefficient companies and industries, facilitating the techno-industrial substitutions. From the cases, it can be seen that the two conditions amplified the feedback impacts from the individual entrepreneurial process to the ecosystem resource exit. Hence, the following proposition can be derived:

P3c. Facilitating techno-industrial substitution and highly re-combinative industrial architecture will strengthen the relationship between resource exploitation behaviours in individual entrepreneurial processes and resource exit in entrepreneurial ecosystems.

Similar to P1b, the three conditions of resource recycling moderate the relationships between resource feedback in individual entrepreneurial processes and resource recycling in ecosystems. For example, the recycling of co-founders and employees from previous companies like Fairchild and Huawei helped later start-ups to grow their businesses, driven by entrepreneurial mind-sets aspiring to join or create start-ups rather than established companies, as well as supportive public or private capital markets that ensured the finances of these start-ups. Attractive living conditions and infrastructure are also critical in ensuring that, when start-ups perform resource feedback, the talents as well as the knowledge and financial resources

embedded with them do not flow to other ecosystems, and instead choose to recycle in the ecosystems. Hence, the following proposition can be derived:

P3d. Attractive living conditions and infrastructure, open-minded and eclectic culture, and supportive public/private capital market will strengthen the relationship between resource feedback behaviours in individual entrepreneurial processes and resource recycling in entrepreneurial ecosystems.

With the first three sets of propositions, the resource dynamisms are illustrated in Figure 6-1 to summarise the findings in terms of individual-level resource dynamisms and ecosystem-level resource dynamisms.

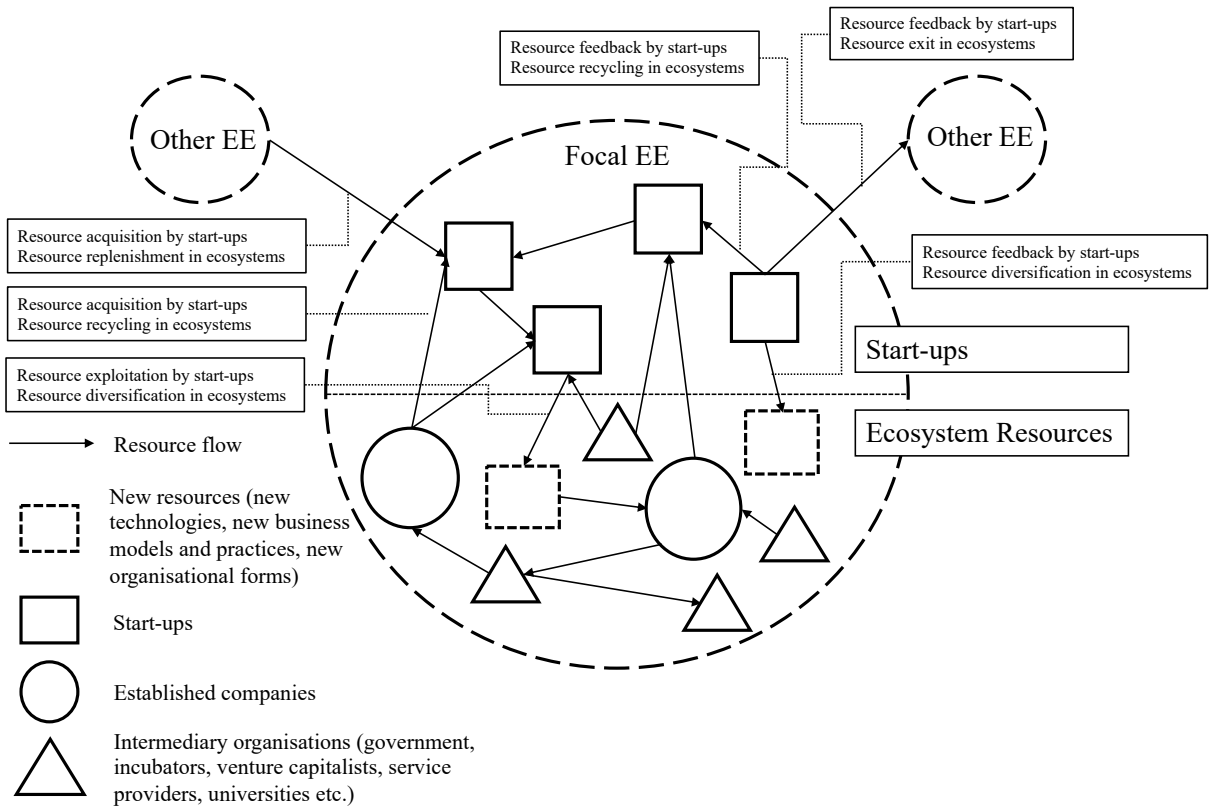


Figure 6–1 Resource dynamisms in entrepreneurial ecosystems

6.5 Resource dynamisms and ecosystem maturity

With the tables above, it is also found that the level of resource dynamism changes over time,

as the ecosystems grow from early stage to mature stage. As can be seen from tables 6-1, 6-3 and 6-4, a general pattern for resource diversification and exit emerges; that is, as the ecosystems become mature, the extent of resource diversification and resource exit becomes less intensive. The fading effect is not surprising because, as the ecosystems become more mature, the resource pools tend to become consolidated and standardised, leaving less room for the diversification of resources and the resource exit coupled with it. The extent of creation of new technologies and substitution of obsolete technologies may not be affected by the growing ecosystem, but it is especially true for organisational resources such as novel organisational forms and business practices related to new venture creations, because the process of new venture creation gets more and more sharpened and comprehensive as the entrepreneurial ecosystem grows. Hence, the following proposition can be derived:

P4a. For a healthy entrepreneurial ecosystem, the extent of resource diversification and resource exit will be lower when the ecosystem becomes more mature.

As is seen from the tables, however, there exists a reverse pattern for resource replenishment and recycling in ecosystems. That is, when an ecosystem becomes more mature, the extent of resource replenishment and recycling in that ecosystem becomes more intensive. This conforms with one's intuition and the reasons are twofold. On the one hand, at the mature stage, as the types of resources are becoming consolidated and standardised, the ecosystem therefore becomes more stable and slightly slows down its pace in terms of the diversification and exit of resources. On the other hand, as the ecosystem becomes more mature, the increased number of start-ups and new venture creation activities inevitably boost the intensity of resource-leveraging behaviours of start-ups within the ecosystem, in particular resource acquisition and feedback activities of individual start-ups, which will collectively lead to a higher level of resource replenishment from outside of the ecosystem and resource recycling within ecosystem. Hence, the following proposition can be derived:

P4b. For a healthy entrepreneurial ecosystem, the extent of resource replenishment and recycling will be higher when the ecosystem becomes more mature

6.6 Summary

This chapter serves to answer the second sub research question 'How do individual entrepreneurial activities contribute to collective entrepreneurial ecosystem health', by identifying the underlying relationships between individual level resource accessing behaviours and the ecosystem level resource dynamisms. All four sets of propositions are summarised in Figure 6-2.

With these propositions, this dissertation not only establishes linkages between individual entrepreneurial behaviours of resource accessing and the aggregated resource dynamisms of the whole ecosystems, but also reveals how resource dynamisms change over time with the evolution of entrepreneurial ecosystems. These propositions also provide future research opportunities in theory testing.

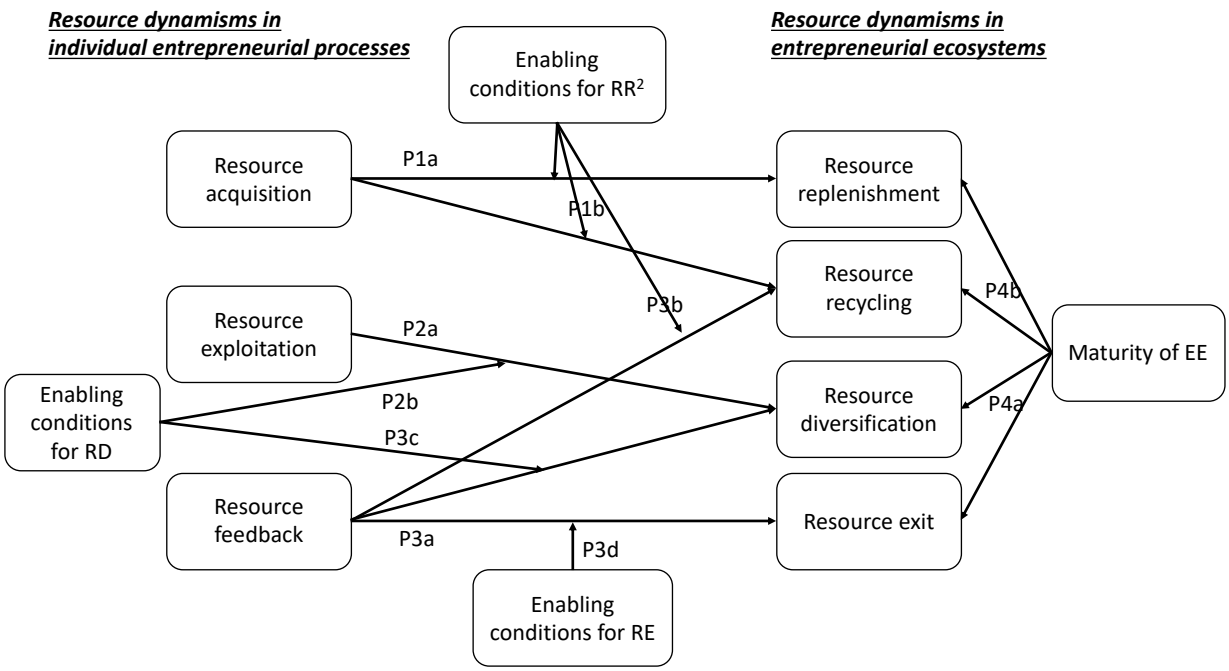


Figure 6–2 Summary of propositions for resource dynamisms

7. An Integrative Process Model: How a Healthy Entrepreneurial Ecosystem Facilitates New Venture Creation

> *[T]alk about ecosystem processes – the mechanisms through which start-ups and scale-ups gain a competitive edge from their regional environments – as well as ecosystems as processes: the ways in which ecosystems are reproduced and transformed over time. Spigel and Harrison* (2018, p.158)

7.1 Introduction

To this end, the key dimensions for entrepreneurial ecosystem health, and the relationships between resource-accessing behaviours in individual entrepreneurial processes and ecosystem resource dynamisms have been revealed. Based on previous findings, this chapter offers an integrative model describing how a healthy entrepreneurial ecosystem durably facilitates new venture creation, as is illustrated in Figure 7-1, in attempt to answering the third sub research question 'How does a healthy entrepreneurial ecosystem facilitate new venture creation'.

This model is comprised of two components - transformation processes and feedback impacts. In the transformation processes, the ecosystem resources are utilised by start-ups through resource acquisition, resource exploitation and resource feedback in their entrepreneurial processes. Upon completion of new venture creations, the transformation processes will have feedback impacts on regional resources. Such feedback impacts are realised through ecosystem robustness and adaptation that are strengthened in the transformation processes, as ecosystem resources are replenished, recycled, exited and diversified due to the aggregated outcomes of resource-accessing behaviours in individual entrepreneurial processes. These resource dynamisms are enabled by conditions illustrated in Figure 7-1 and demonstrated in chapters 5 and 6. The feedback impacts on the ecosystem resources will prepare the ecosystem for the

next round of new venture creation. In this sense, the transformation processes and feedback impacts together form a closed loop, revealing how a healthy entrepreneurial ecosystem can sustain new venture creation even upon external disruption. With this model, a formal definition of entrepreneurial ecosystem health from an entrepreneurial process (dynamic) perspective is provided to end this chapter.

7.2 Transformation processes: new venture creation with ecosystem resources

The first part of the model involves the transformation processes of regional entrepreneurial ecosystem resources into new ventures, through the individual entrepreneurial processes. In the transformation processes, ecosystem resources are exploited by entrepreneurs to create new ventures. Collectively, this contributes to the ecosystem performance of new venture creation.

Specifically, as is shown in Chapter 5, supply-side resources including human capital and financial resources are acquired in the opportunity and organisational creation stages. The resource acquisition is often coupled with resource exploitation of *ex ante* or *ex post* intermediary resources such as social capitals, especially in searching for co-founders and sourcing financial support from friends and family. Resource exploitation is also evident in the organisational creation and technology set-up stages when entrepreneurs utilise the supply-side and intermediary resources to develop other core assets, such as key technologies and business models, settling legal and accounting issues. Similarly, resource exploitation is coupled with resource acquisition. For example, as the start-up grows, intermediary resources such as social networks can grow and potentially bring the company more opportunities in investment and talent acquisition. In the market exchange stage, start-ups could tap into local markets and demand-side resources, while continuing to exploit supply-side resources such as production, financial, and intermediary resources. Certainly, many start-ups nowadays are born global, serving the international market upon creation. In this case, they may still exploit the ecosystem resources as other local organisations may possess the knowledge and capabilities required for the global market and are sometimes well connected to players in the international market.

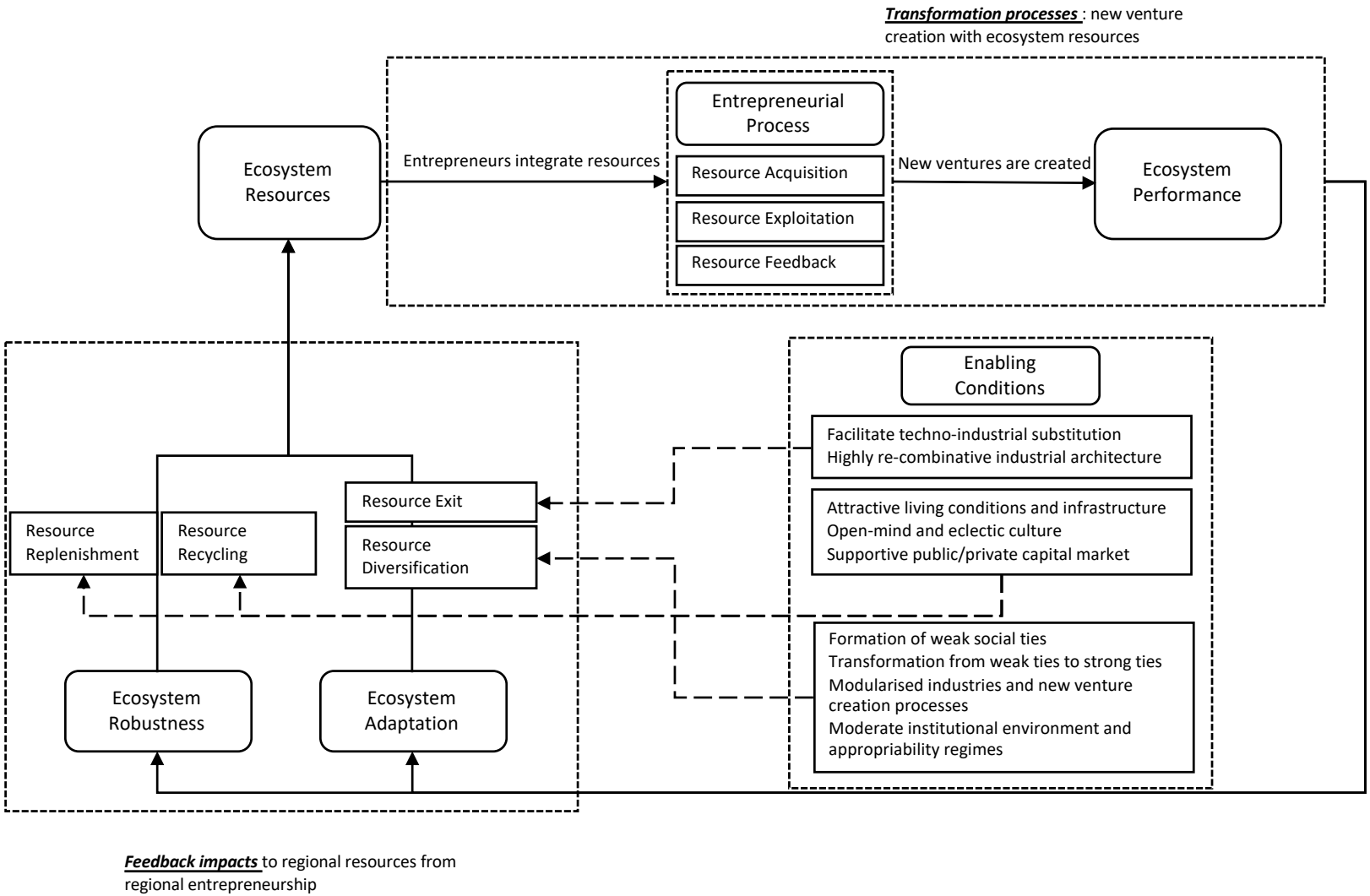


Figure 7–1 An integrative process model for new venture creation in entrepreneurial ecosystems

When market entry is successful, the start-up could either fail or succeed in the subsequent market competition. Regardless of the outcomes of the new venture creation – be it failure, or acquisition by multinationals, or fortunately reaching the IPO – the start-up will release the resources acquired and also generated by itself through exploiting ecosystem resources, upon completion of the new venture creation processes. For example, employees or co-founders could again start new companies or join other companies, bringing their technologies, tacit knowledge, or organisational forms and routines into other companies in the ecosystem.

Collectively, the transformation processes create new ventures in the entrepreneurial ecosystems by tapping into various ecosystem resources. As is shown in Chapter 6, the individual entrepreneurial behaviours of resource acquisition, resource exploitation and resource feedback will have feedback impacts for ecosystem resources. In other words, the transformation processes will collectively yield feedback impacts on ecosystem resources, which ultimately forms a closed loop and facilitates the next round of new venture creation processes in the ecosystem.

7.3 Feedback impacts on ecosystem resources from regional entrepreneurship

The feedback impacts on ecosystem resources from the transformation processes result from four underlying resource dynamisms, namely resource replenishment, resource recycling, resource diversification and resource exit, as is shown in chapters 5 and 6.

Resource replenishment enables the key supply-side resources such as human resources and financial resources to be continuously attracted from outside of an ecosystem. These resources can be from other competing entrepreneurial ecosystems in the same country, or even from outside of the home country. As is shown in chapters 5 and 6, resource replenishment often has network effects: the more talents and financial capital agglomerate, the more intensified the entrepreneurial activities will be in the ecosystem, and vice versa. From the evidence on the entrepreneurial processes of key companies in different stages in both Shenzhen and Silicon

Valley, resource replenishment in the macro entrepreneurial ecosystem level results from resource acquisition in the micro individual entrepreneurial process level. This is because, as entrepreneurs acquire resources, they do not only acquire them from within the ecosystem. Rather, they often bring talents and investments from outside of the ecosystem. Once these resources enter the focal ecosystem, resource replenishment is fulfilled.

However, resources being attracted to the focal entrepreneurial ecosystem can theoretically flow to other ecosystems if the focal ecosystem cannot retain them or when other competing ecosystems are more attractive. Resource recycling, in this sense, serves as the second resource dynamism to ensure that the financial and human resources can recycle in the focal ecosystem to continuously create new ventures (see also Spigel and Harrison, 2017). As is pointed out in Chapter 5, this does not mean locking in these resources in the ecosystem. Rather, well-functioning resource dynamisms could ensure that the net resource flow is positive towards the focal ecosystem. Again, from our evidence in Shenzhen and Silicon Valley's entrepreneurial processes of key companies in different stages, resource recycling in the macro entrepreneurial ecosystem level results from resource acquisition and resource feedback in the micro individual entrepreneurial process level. This is because, when entrepreneurs acquire resources during their opportunity and organisational creation stages, they may well utilise the ex-ante ecosystem resources such as serial entrepreneurs and individual investors who were once successful entrepreneurs themselves. Similarly, when the new venture creation is near completion, the resources acquired and created by the new venture will be released into the ecosystem and provide further opportunities for other new ventures to utilise and exploit again.

The extent of resource replenishment and recycling is contingent on three enabling conditions – attractive living conditions and infrastructure, open-minded and eclectic culture, and supportive private and public capital markets, as is explained in chapters 5 and 6. Together, resource replenishment and recycling increase the ecosystem robustness. This is because these two mechanisms attract and retain key supply-side resources to keep the ecosystem functioning. They do not create anything new but provide sufficient elements for the ecosystem to sustain its current status and performance in new venture creation, without drifting away to potential

failure. However, this is true only in the absence of external disruptions, which could be major technological change resulting in paradigm shifts or financial crisis that reduced market demand significantly for particular segments.

When the ecosystem faces external disruptions, there are not enough new resources in its existing resource pool[13] to adapt to the new environment. For example, adoption of new technologies is needed when the existing industries are being disrupted; new organisational forms such as venture capitalists and incubators are essential to scale-up start-ups when they are vulnerable in the turbulent market. In these circumstances, resource diversification could create new resources for the ecosystem. These new resources can be supply-side resources such as new technologies and intermediary resources such as emergence of new organisational forms, new business models and practices. From the evidence on the entrepreneurial processes of Shenzhen and Silicon Valley's key companies in different stages, resource diversification in the macro entrepreneurial ecosystem level results from resource exploitation and feedback in the micro individual entrepreneurial process level. This is because new resources could be created when entrepreneurs exploit existing resources, for example, developing new technologies with the co-founders and employees. New resources could also be created at the end of the new venture creation process, when entrepreneurs and start-ups release their resources back into the ecosystem and these are further diffused into other organisations in the ecosystem, including commercialising new technologies as a spin-off and establishing organisations with new business models after their successful venture creation. The extent of resource diversification is contingent on four enabling conditions, formation of weak social ties, transformation from weak ties to strong ties, modularised industries and new venture creation processes, as well as moderate institutional environment and appropriability regimes.

However, resource diversification only ensures the creation of new resources, but cannot guarantee the embeddedness of the new resources in the ecosystem – there needs to be enough

[13] One could also relate the 'resource pool' concept in this dissertation to 'untraded interdependency' (Storper, 1995)

space for the new resources to come into existence. In other words, it is essential for obsolete resources to exit the ecosystem in order to make way for resource diversification. Therefore, resource exit serves as the final resource dynamism to facilitate the withdrawal of obsolete or inefficient resources. Similar to resource diversification, resource exit could include substitution of existing technologies and decline of obsolete industries. From our evidence on the entrepreneurial processes of Shenzhen and Silicon Valley's key companies in different stages, resource exit in the macro entrepreneurial ecosystem level results from resource feedback in the micro individual entrepreneurial process level, as resource exit is often coupled with the results of successful new venture creations such as the commercialisation of new technologies and new business models. In other words, resource exit can be considered as one of the outcomes brought by the resource feedback at the end of the individual entrepreneurial process. The extent of resource exit is contingent on two enabling conditions – highly re-combinative industry architecture facilitating techno-industrial substitutions.

Together, resource diversification and exit could increase the ecosystem adaptation, because they create and make space correspondingly for new resources that are required for the ecosystem to cope with the turbulence and disruptions often brought by new technologies and macro-economic incidents. With the new resources, the ecosystem will be able to adapt to the next possible status that reconciles with the disruptive events. In the meantime, it is also critical for obsolete supply-side and intermediary resources to exit the ecosystem in a timely manner, in order to create more space for the aforementioned new resources to emerge.

7.4 Defining entrepreneurial ecosystem health: a dynamic view

The process model offers new insights into the evolution of the entrepreneurial ecosystem, in particular how the ecosystem continuously creates new ventures with the evolving resource pool. It is argued that such a changing resource pool is the outcome of the new venture creation activities in the ecosystem. With the dimensions of entrepreneurial ecosystem health and their internal linkages reflected by the process model, entrepreneurial ecosystem health can now be formally defined as follows:

<u>Definition of Entrepreneurial Ecosystem Health</u>: Entrepreneurial ecosystem health consists of six dimensions, namely ecosystem resources, entrepreneurial process, ecosystem performance, ecosystem robustness and ecosystem adaptation, as well as enabling conditions for resource dynamisms. It divulges the current performance of new venture creation in the entrepreneurial ecosystem and the expectation of sustaining or growing its ability to continuously create new ventures.

The definition reflects both the static and dynamic parts of research findings on entrepreneurial ecosystem health. The static part – ecosystem resources and ecosystem performance – represents the traditional linear dimensions in assessing regional entrepreneurship. The dynamic part – entrepreneurial process, ecosystem robustness and adaptation as well as the enabling conditions for resource dynamisms – takes the evolving nature of entrepreneurial ecosystems and individual entrepreneurial processes into consideration and demonstrates how these dynamics affect the new venture creation activities. In this sense, the entrepreneurial ecosystem health framework seeks to capture the dynamics along the full cycle of new venture creation process in the entrepreneurial ecosystems. This is akin to observing the motion status of a moving object in Newtonian mechanics, where both velocity and acceleration need to be considered, as velocity represents the current status of motion in terms of magnitude and direction (as a vector), and acceleration represents the expected status of motion in terms of magnitude and direction in the future. It is argued that, the definition of entrepreneurial ecosystem health proposed in this research indicates not only how ecosystems perform now in terms of new venture creation, but also how well they could be in the future.

7.5 Summary

This chapter explicates a process model to answer the third sub research question ‘How does a healthy entrepreneurial ecosystem facilitate new venture creation’. The process model presents a closed loop that details how a healthy entrepreneurial ecosystem could durably facilitate new venture creation even upon external disruption. A formal definition of entrepreneurial ecosystem health taking a dynamic and process perspective is proposed.

8. Discussions

8.1 Introduction

Based on the research findings presented in previous chapters, Chapter 8 attempts to discuss the contributions to theory and practice. Research limitations and future opportunities are also outlined.

8.2 Theoretical contributions

This dissertation contributes to entrepreneurial ecosystem literature with the entrepreneurial ecosystem health framework, and regional entrepreneurship literature by shedding light on the reciprocity between new venture creation activities and ecosystem resources. The author also aspires to bridge the micro entrepreneurial resource acquisition behaviours with the emerging ecosystem literature. Finally, a resource-based account of entrepreneurial ecosystems is offered, highlighting the significance of supply-side resources, as a complement to the extant demand-side view of ecosystems.

8.2.1 Understanding entrepreneurial ecosystem health

The framework of entrepreneurial ecosystem health proposed in this dissertation differs from previous concepts and thus contributes to entrepreneurial ecosystem literature in three ways. First, by identifying the dimensions of entrepreneurial ecosystem health, this research advances understanding of entrepreneurial ecosystems. As a relatively new domain, although extant literature has identified the configurations and key players/components of an entrepreneurial ecosystem (Cohen, 2006; Isenberg, 2011; Shi and Shi, 2016; Spigel, 2017; Spilling, 1996), research has significantly lagged behind in terms of the competitiveness and performance of an entrepreneurial ecosystem. The health of an ecosystem is critical in that it affects the fate of all ecosystem actors (Iansiti and Levien, 2004a). The conceptualisation of entrepreneurial

ecosystem health is the first attempt and offers opportunities to further advance understanding of entrepreneurial ecosystems.

Second, by offering an entrepreneurial process perspective of understanding ecosystem health, this dissertation offers a dynamic framework of ecosystem health, and echoes the call for an evolutionary perspective in entrepreneurial ecosystem research (Mack and Mayer, 2015; Spigel, 2017). Extant literature treats health as a rather static concept, making it confusingly similar to related concepts such as determinants of regional entrepreneurship and regional innovation systems (Armington and Acs, 2002; Fritsch and Slavtchev, 2011; Tamásy, 2006). However, the research findings show that to evaluate an entrepreneurial ecosystem's health is much more than evaluating merely its performance. Due to the dynamic, evolutionary nature of ecosystems (Liu and Rong, 2015), the health of entrepreneurial ecosystems goes beyond transient measures (snapshots) of performance. It instead includes the future expectation of the ecosystem's development. In other words, the prosperity of a region at a certain point does not necessarily indicate that it can still be healthy after some time. On the contrary, it may well decline in the future if the ecosystem resilience is not as satisfactory as before. To understand this better, one can relate it to evaluating an object's state of motion in Newtonian mechanics, where both transient velocity and acceleration are needed in order to fully capture its motion at this time and in the future. Therefore, with an entrepreneurial process perspective, it is argued that the health of an entrepreneurial ecosystem is subject to an examination of the whole new venture creation process in the ecosystem.

Thirdly and also relating to the second aspect, traditional literature on performance of clusters, regional innovation systems or determinants of regional entrepreneurship tends to address the comprehensiveness of regional structures and resources (Eisingerich, Bell, and Tracey, 2010; Fritsch and Slavtchev, 2011; Tamásy, 2006). However, it is argued that the health of entrepreneurial ecosystems is far beyond the comprehensiveness of resources and structures, but is also dependent on the resource dynamisms. In other words, it is not enough to just possess the necessary resources and elements to innovate and create new ventures – what is equally important is to facilitate the flow of and interactions between these resources, be they new

resources or existing resources or obsolete resources. In this sense, the dynamisms are the key for the ecosystem to flourish and continuously create new ventures, which also echoes Spigel and Harrison (2018) that the resource flow is critical for a well-functioning ecosystem.

8.2.2 Regional entrepreneurship's feedback impacts for regional structures/context

This dissertation also contributes to the regional entrepreneurship literature by elaborating on the feedback impacts of regional entrepreneurship to regional structures and identifying the mechanisms of how regional entrepreneurship could reinforce regional resources/structures.

In regional entrepreneurship, there is extensive literature discussing how regional resources and regional context are positively associated with new venture creation in a region (e.g. Audretsch & Fritsch 1994; Georgellis & Wall 2000; Armington & Acs 2002). Extant literature also unveils the pivotal role of regional entrepreneurship in regional development (e.g. Audretsch & Fritsch 2002; Pike et al. 2007). However, less light is shed on the reciprocity in these relationships, in particular, whether regional entrepreneurship impacts on regional contexts (Müller, 2016). Examining this interplay is urgent in the sense that these factors co-evolve over time and traditional unidirectional considerations cannot fully understand the dynamics and variations in the entrepreneurial ecosystems.

The conceptualisation of entrepreneurial ecosystem health has revealed how regional entrepreneurship feeds back into regional resources and context. It is argued that new venture creation activities will in turn have feedback impacts on regional resource/structure, via individual resource acquisition activities in the entrepreneurial processes. The four resource dynamisms, being resource replenishment and recycling for existing resources, as well as resource diversification for new resources and resource exit for obsolete resources, incurred by resource acquisition in new venture creation activities in the ecosystem will contribute to the expansion and transformation of ecosystem resources. The resource dynamisms also chime with Spigel and Harrison's (2018) conceptualisation of how resources can flow in the

entrepreneurial ecosystems but differ from them in that this research specifically sheds light on the antecedents and outcomes of these mechanisms. These mechanisms also entail some of the arguments in economic geography such as Myrdal's circular causation theory (Myrdal, 1957) and Arthur's positive feedback theory (Arthur, 1989).

8.2.3 Linking (micro) entrepreneurial process with (macro) entrepreneurial ecosystems

The research findings also contribute to bridging the traditional entrepreneurial acquisition (Starr and Macmillan, 1990) literature with the burgeoning entrepreneurial ecosystem literature. Extant ecosystem literature largely focuses on what the entrepreneurial ecosystem contains and how such an ecosystem promotes regional entrepreneurship (Isenberg, 2011; Mason and Brown, 2014; Spigel, 2017). However, very few studies consider the ecosystem benefits from the entrepreneur's perspective, thus losing a significant part of what an entrepreneurial ecosystem is supposed to serve.

Prior studies in resource acquisition of start-ups highlight the need to facilitate new ventures' resource acquisition behaviours, as – unlike for established firms – these are more important than deploying resources (Lichtenstein and Brush, 2001), and new ventures inevitably suffer from multiple issues in identifying, attracting and combining resources to create their resource platform to yield corresponding capabilities (Brush, Greene, and Hart, 2001) due to liability of newness. Further research has identified different approaches in acquiring resources for new ventures, such as through storytelling (Martens *et al.*, 2007) and indirect ties (Zhang, Soh, and Wong, 2010). Yet, little is known regarding how entrepreneurs access and acquire resources from entrepreneurial ecosystems, although extant literature frequently argues that ecosystems provide resources to entrepreneurs.

The research findings offer insights into how entrepreneurs access resources from the ecosystems and, more importantly, reveal how their resource acquisition behaviours in turn change the resource pool of the entrepreneurial ecosystems. As the first attempt to bridge the

two streams of literature, the author also aspires to add to the meaningfulness of entrepreneurial ecosystems.

8.2.4 Towards a resource-based view of entrepreneurial ecosystems

Extant literature on ecosystems, be it business ecosystems (Moore 1993, 1996; Iansiti & Levien 2004a, 2004b; Rong & Shi 2014; Liu & Rong 2015; Rong et al. 2015) or innovation ecosystems (Adner 2006, 2012; Adner & Kapoor 2010; Adner 2017; Jacobides et al. 2018), has largely focused on the *demand-side* of the ecosystems. It is argued that ecosystems are designed and nurtured by focal firms in order to meet customer demand, and follow the inherent structure brought by interdependence of technologies. This demand-driven view highlights the necessity of identifying, managing and orchestrating *complementors* in an ecosystem to co-create value in an attempt to meet the ever-changing demand of end customers (Jacobides *et al.*, 2018). Although entrepreneurial ecosystem literature is starting to appreciate the vitality of location as well as the resources embedded within it, extant literature still limits its discussion to the *intermediary* roles – incubators, universities, governments and science parks. Certainly, these players are crucial for the development of entrepreneurial ecosystems and new venture creation within these ecosystems. However, fundamentally, what drives the development of the local entrepreneurial ecosystem is the *resource* – the *supply side* that truly facilitates the new venture creation with the resource dynamisms of the entrepreneurial ecosystems.

This is not to say that the demand side is not important. Rather, it is to say that the supply side is equally as important as the demand side, if not more so. This is akin to the debate in supply-side or demand-side economics on which side is more effective when it comes to stimulating the economy. The orchestrators of entrepreneurial ecosystems should consider the enabling conditions that alter and mobilise ecosystem resources in order to facilitate new venture creation in the ecosystem, rather than pursuing the completeness or comprehensiveness of resources, or intermediaries. Just building up incubators or purely pouring in money is simply not a sustainable model for an entrepreneurial ecosystem to flourish.

In this sense, it is argued that entrepreneurial ecosystems are *bundles of regional resources*. Differing from the resource-based view of firms in pursuit of the value, rareness, imitability and substitutability of the resource bundling (Barney 1991, 2001), the resource-based view of ecosystems, address the importance of resource dynamisms, i.e. replenishment, recycling, diversification and exit, within and outside of the ecosystems. In other words, although resources are heterogeneously distributed across different regional entrepreneurial ecosystems, as in the case of firm resources, the nature of the resources across different ecosystems is homogenous and highly mobilised, as these resources are not necessarily geographically bounded in the sense that they can flow from one ecosystem to another ecosystem with few constraints, unlike firm resources. For example, human and financial resources could flow freely to maximise their utilities; organisations could relocate or expand to other geographical areas where, for example, costs are lower, or technologies are more accessible. In the traditional firm-level resource-based view, resource dynamisms are implicit and to some extent self-evident, because firms constantly mobilise the resources they possess regardless of the effectiveness, and resources and capabilities are not easily transferable from organisation to organisation because they are 'firm-specific' in nature. This means, unlike the case of firm resources, ecosystems that are solely nurturing and/or possessing valuable, rare, non-imitable and non-substitutable resources do not automatically obtain competitive advantages over other ecosystems; rather, ecosystems that possess well-functioning resource dynamisms will stand out. This is because, in the case of entrepreneurial ecosystems, resources are free flowing from one ecosystem to another.

The antecedents of ecosystem resources, however, stem from ecosystem actors' activities. As is shown in chapters 5 and 6, ecosystem resources are created, altered and accumulated during individual entrepreneurial processes. From an individual entrepreneur's perspective, resources and capabilities tend to accumulate over time as the entrepreneur engages in the new venture creation process (Ucbasaran, Westhead, and Wright, 2001). Therefore, when taking an ecosystem perspective, collective accumulation of entrepreneurial resources and capabilities in the individual entrepreneurial processes over time gradually constructs a resource pool, which contains various resources that can be mobilised and valorised by other new ventures in the

region. In this sense, this research also offers insights into the emergence of an entrepreneurial ecosystem, which echoes with Thompson *et al.*'s (2018) work on how Seattle's entrepreneurial ecosystem takes form via the accumulative activities of various actors.

The outcomes of ecosystem resource-based accounts are also different from those of a firm's. The traditional resource-based view of firms contends that deploying the bundles of resources will yield capabilities that could be used by the firms to obtain competitive advantages (Wernerfelt 1984; Barney 1991, 2016). However, unlike the traditional resource-based view of firms addressing the need to possess the unique *resource bundling in pursuit of competitive advantages*, the resource-based view of ecosystems addresses the necessity of facilitating sufficient *resource dynamisms* within and outside of the ecosystems *in pursuit of ecosystem health*. To this end, a resource-based account of entrepreneurial ecosystems is provided, with its antecedents and outcomes explained, as is illustrated in Figure 8-1.

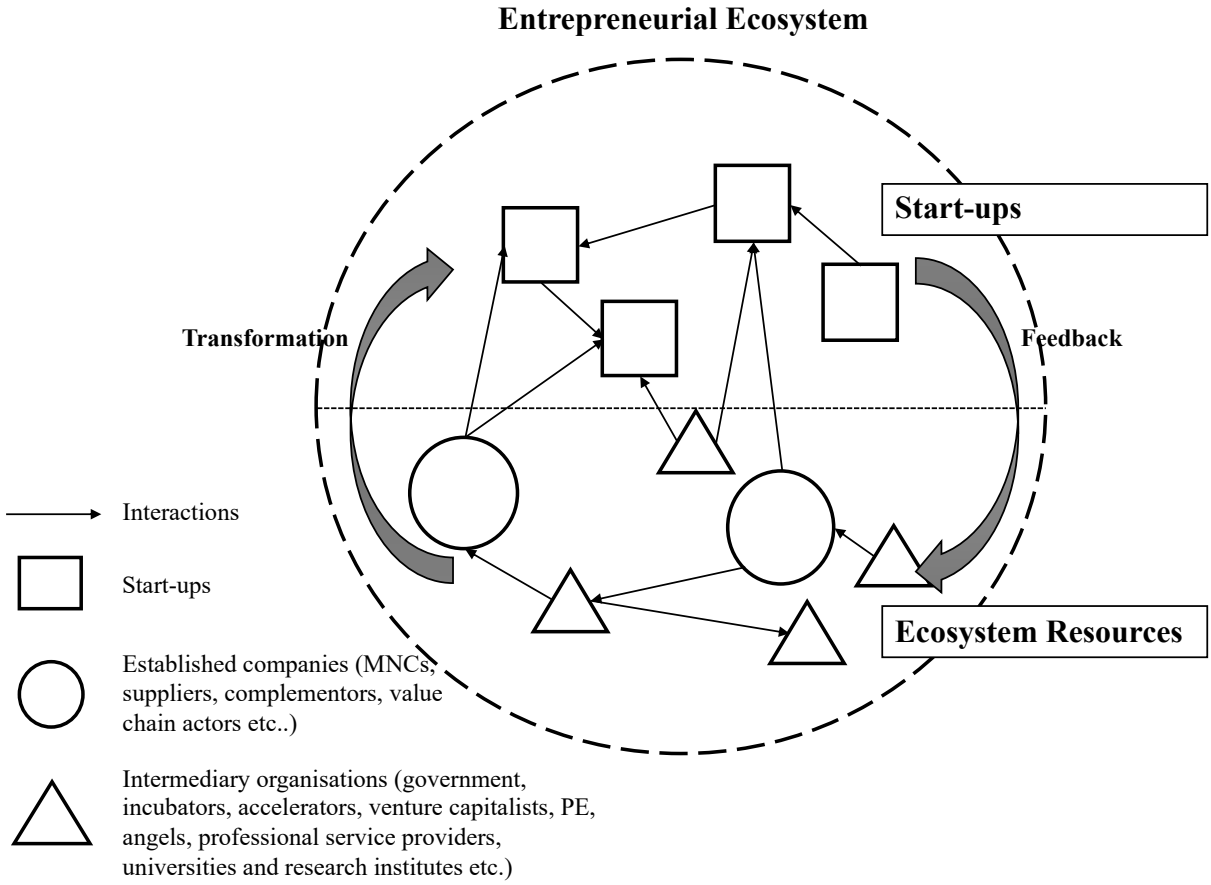


Figure 8–1 A resource-based account of entrepreneurial ecosystems

8.3 Practical implications

This dissertation has implications for both policy makers and entrepreneurs.

8.3.1 Policy Implications

This research has significant policy implications, in terms of ecosystem health assessment and the roles governments should play in managing their regions.

First, regional policymakers could be informed with more insights into how well the ecosystems perform in terms of new venture creation. By assessing each dimension of the health of entrepreneurial ecosystems, policymakers will be able to issue relevant policies to support the regions' overall prosperity. In this way, the government bodies can promote coordination and cooperation among all stakeholders within the ecosystems in order to maximise the economic return and societal utilities.

Second, policymakers would also be able to pursue specific dimensions and targets as per the developmental stages of their regions, based on the result of health assessment. For example, for resource-scarce regions, policy makers could put more emphasis on attracting resources (financial and human capital) from outside of the ecosystems; for resource-munificent regions, the focus could be on how to retain and recycle current resources within the ecosystems, and in particular, how to create new resources with the current resource bases. In general, regional governments should take into account the endowment of their regions – it is much more important for an entrepreneurial ecosystem to have one or some particularly strong dimensions than one with average ratings on all dimensions because strong dimensions could serve as a good starting point to lead the ecosystem into a virtuous cycle.

Third, with the enabling conditions for facilitating resource dynamisms within the ecosystems, a highlight of this dissertation for policymakers is about resource (re-)configurations in the ecosystems. Questions that still remain among policymakers such as "do I get a Silicon Valley by putting the same resources in my city?" show that considerable misunderstanding persists

on the *de facto* determinants of ecosystem health. As a rule of thumb, simply pouring resources into the ecosystems do not necessarily work, which ties back to the concerns over some of the initiatives regarding entrepreneurship in China in particular – government bodies tend to put efforts into creating an ecosystem with all kinds of resources. Instead, according to the research findings, facilitating the resource dynamisms within and outside of the ecosystems is the utmost important factor in determining the prosperity of the ecosystems. In this sense, government bodies should steer their policy directions to the enabling conditions demonstrated in the research findings, such as facilitating weak tie formation and strong tie transformation. In this way, they act as facilitators, rather than orchestrators.

8.3.2 Implications for entrepreneurs

First, for entrepreneurs who are considering where to locate their start-up, this research provides a framework for them to assess the health of the entrepreneurial ecosystems in which they are considering starting their business.

Second, this research sheds light on how individual entrepreneurs access resources from the entrepreneurial ecosystems as well as the impacts of such resource-accessing behaviours, thus informing entrepreneurs about what resources they can expect from the local entrepreneurial ecosystems at different stages of their venture creation processes and how to access these resources.

Third, this dissertation brings individual entrepreneurs the 'ecosystem' perspective to consider their personal success and failure in the wider context and inform them that short-term failure could result in resource feedback to the ecosystem in which they are embedded, which could potentially help them launch successful businesses in their future endeavours. This provides a rational explanation for serial entrepreneurs.

8.4 Research limitations

Besides the contributions, this research has the following limitations.

First, although the nature of case studies offers opportunities to reveal insights for entrepreneurial ecosystem health and resource dynamisms, generalisability problems exist. While the author is intended to make every effort to claim a generalisable framework, as the data focuses primarily on ICT industry in Shenzhen and Silicon Valley, limitations in generalisability may exist because industrial, regional, and country-level heterogeneities could influence the current results.

Second, the author is aware that the cases are successful entrepreneurial ecosystems. Although this research is focused on revealing the successful factors and dimensions of the entrepreneurial ecosystems, lack of failed cases limits the explanatory power of the current framework.

Finally, employing a qualitative approach only yields key dimensions of the framework but it is still far from operationalisation. The author is aware that large scale quantitative method could be a complementary approach to enrich and operationalise the framework, which could be used when developing the tool for assessing entrepreneurial ecosystem health.

8.5 Future research

Based on previous discussions and research limitations, future research could focus on the following aspects:

- A comparison study could be made on the basis of current findings for Shenzhen and Silicon Valley. Such a comparison study may yield more insights in the way entrepreneurial ecosystems are organised and governed, under different cultural norms, industrial architectures and political regimes.

- Conducting complementary case studies to enhance the robustness of the current framework and potentially generate new insights pertaining to the heterogeneities between regions and industries. This could be through either studying different industries such as biotech in the same regions, or different regions in other economies such as in Europe.

- Exploring ‘failed’ entrepreneurial ecosystems. Further research could look into failed ecosystems in order to gain a more comprehensive understanding by particularly examining what dimensions are absent in these failing ecosystems. This could provide opportunities for cross checking and enriching the health framework.

- Tool development for assessing entrepreneurial ecosystem health. Future research could also focus on developing a health assessment tool for regional entrepreneurial ecosystems, which can be readily used by regional policymakers to review their regional development and entrepreneurs to decide where to locate their start-ups.

8.6 Summary

This chapter highlights the theoretical contributions to entrepreneurial ecosystem, regional entrepreneurship and entrepreneurial behaviour literature. It also discusses practical implications for both policy makers and individual entrepreneurs. Research limitations and future research opportunities are also outlined to end this chapter.

9. Conclusions

Although discussions around entrepreneurship and regional development have burgeoned among academics, policymakers and industry practitioners, a fundamental question still challenges policy makers and industry practitioners: what makes an entrepreneurial region stand out among the crowds? On the one hand, regional entrepreneurship literature highlights the impacts of regional context and structures on regional entrepreneurship, but fails to reveal the reciprocity between them, i.e., how regional entrepreneurship could in turn benefit regional context in order to sustain the new venture creation activities over time. On the other hand, although entrepreneurial ecosystem literature provides a new perspective to understand regional entrepreneurship in context by shedding light on the structures and building blocks of an entrepreneurial ecosystem, relatively less is known about what dimensions and factors contribute to the performance and competitiveness that signify the ecosystem's ability to continuously create new ventures in the region. Hence, this research asks: how do we unpack the health of an entrepreneurial ecosystem?

Following an inductive approach, a qualitative study on two exemplary entrepreneurial ecosystems – Silicon Valley, US, and Shenzhen, China – was conducted. For each ecosystem, its evolution over time was revealed first, highlighting critical events and start-ups in different lifecycle stages of the entrepreneurial ecosystem. Then the entrepreneurial processes of key start-ups – Fairchild-Intel, Apple, Google and Tesla in Silicon Valley and Huawei, Tencent and DJI in Shenzhen – as well as their interactions with the ecosystems were analysed. The primary data is mainly from semi-structured interviews with informants pertinent to different players in the ecosystems, as well as employees who are familiar with the entrepreneurial processes of the key companies identified. Primary data was complemented and triangulated with secondary data mainly from academic papers, archives, online articles from reliable sources, books and monographs, as well as biographies of key companies and their founders, etc.

Findings in relation to research sub-question 1: What are the dimensions for

entrepreneurial ecosystem health?

The research finding shows that entrepreneurial ecosystem health consists of six dimensions:

- Ecosystem resources (supply-side, intermediary and demand-side resources)
- Entrepreneurial process (resource acquisition in opportunity and organisational creation stages, resource exploitation in organisational creation and technology set-up stages, resource feedback in market exchange and exit stages)
- Ecosystem performance (regional economic impact and regional entrepreneurship performance)
- Ecosystem robustness (resource replenishment and recycling)
- Ecosystem adaptation (resource diversification and exit)
- Enabling conditions for resource dynamisms (conditions for resource replenishment and recycling, for resource diversification, as well as for resource exit)

Findings in relation to research sub-question 2: How do individual entrepreneurial activities contribute to collective entrepreneurial ecosystem health?

This dissertation also sheds light on how resource acquisition, exploitation and feedback in individual entrepreneurial processes contribute to the resource dynamisms in entrepreneurial ecosystems, and how these relationships are enabled by the three sets of conditions detailed in chapter 5 and 6. A summary of these propositions is provided in Figure 6-2.

Findings in relation to research sub-question 3: **How does a healthy entrepreneurial ecosystem facilitate new venture creation?**

With the dimensions of ecosystem health and resource dynamisms, an integrated process model revealing how a healthy entrepreneurial ecosystem continuously creates new ventures is provided, illustrated in Figure 7-1. It is argued that, with an entrepreneurial process perspective, the health of an entrepreneurial ecosystem divulges its performance in relation to new venture creation and the expectation of sustaining or growing its ability to continuously create new

ventures.

This dissertation seeks to contribute to entrepreneurial ecosystem literature with the conceptualisation of entrepreneurial ecosystem health. The resource dynamisms bridge the gap between individual entrepreneurs and entrepreneurial ecosystems and shed light on how resource-accessing behaviours in individual entrepreneurial processes contribute to the ecosystem-level resource dynamisms. The integrative process model contributes to the regional entrepreneurship literature by elaborating on the feedback impacts of regional entrepreneurship on regional resources. Finally, a resource-based view of entrepreneurial ecosystems is provided, which addresses the necessity of facilitating sufficient resource dynamisms within and outside of the ecosystems *in pursuit of ecosystem health*.

This dissertation has implications for governments to guide their policy initiatives by informing them the health of regional entrepreneurial ecosystems and potential directions for resource (re-)configurations in the ecosystems in order to maximise the economic return and societal utilities. It also has implications for individual entrepreneurs in terms of their location choices and how to leverage resources of the ecosystem in which they reside.

As in any other qualitative work, generalisability problems exist. Future work could focus on drawing comparisons between Shenzhen and Silicon Valley to yield new insights. More case studies on different regions, particularly those 'failed regions', should be explored to enrich the current framework. The author also realises that this framework is far from operationalisation. It is therefore imperative to focus on operationalising the health of entrepreneurial ecosystems in order to provide a readily available tool for policymakers to assess their regions.

Bibliography

Acs ZJ, Armington C. 2004. Employment growth and entrepreneurial activity in cities. *Regional Studies* **38**(8): 911–927.

Acs ZJ, Stam E, Audretsch DB, O'Connor A. 2017. The lineages of the entrepreneurial ecosystem approach. *Small Business Economics*. Small Business Economics **49**(1): 1–10.

Adner R. 2006. Match your innovation strategy to your innovation ecosystem. *Harvard Business Review* **84**(4): 98.

Adner R. 2012. *The wide lens: A new strategy for innovation*. Penguin UK.

Adner R. 2017. Ecosystem as Structure: An Actionable Construct for Strategy. *Journal of Management* **43**(1): 39–58.

Adner R, Kapoor R. 2010. Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal* **31**(3): 306–333.

Adner R, Kapoor R. 2016. Innovation ecosystems and the pace of substitution: Re-examining technology S-curves. *Strategic Management Journal* **37**(4): 625–648.

Agarwal R, Audretsch D, Sarkar MB. 2007. The process of creative construction: knowledge spillovers, entrepreneurship, and economic growth. *Strategic Entrepreneurship Journal* **1**(3/4): 263–286.

Agarwal R, Audretsch D, Sarkar MB. 2010. Knowledge spillovers and strategic entrepreneurship. *Strategic Entrepreneurship Journal* **4**(4): 271–283.

Alfred Marshall. 1920. *Principles of Economics*, 8th ed. London: Macmillan.

Altman EI. 1968. The Prediction of Corporate Bankruptcy: A Discriminant Analysis. *Journal of Finance* **23**(1): 193–194.

Altman EI, Haldeman RG, Narayanan P. 1977. ZETATM analysis A new model to identify bankruptcy risk of corporations. *Journal of Banking & Finance* **1**(1): 29–54.

Alvedalen J, Boschma R. 2017. A critical review of entrepreneurial ecosystems research: towards a future research agenda. *European Planning Studies* **25**(6): 1–25.

Anderson A, Park J, Jack S. 2007. Entrepreneurial Social Capital: Conceptualizing Social Capital in New High-tech Firms. *International Small Business Journal* **25**(3): 245–272.

Ansari SS, Raghu G, Kumaraswamy A. 2016. The disruptor's dilemma: TiVo and the US television ecosystem. *Strategic Management Journal* **37**(9): 1829–1853.

Armington C, Acs ZJ. 2002. The determinants of regional variation in new firm formation. *Regional Studies* **36**(1): 33–45.

Arthur WB. 1989. Competing Technologies, Increasing Returns, and Lock-In by Historical Events. *The Economic Journal* **99**(394): 116–131.

Asheim BT, Coenen L. 2005. Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy* **34**: 1173–1190.

Asheim BT, Isaksen A. 2002. Regional Innovation Systems: The Integration of Local

'Sticky' and Global 'Ubiquitous' Knowledge. *Journal of Technology Transfer* **27**(1): 77–86.

Audretsch DB, Belitski M. 2016. Entrepreneurial ecosystems in cities: establishing the framework conditions. *Journal of Technology Transfer*. Springer US : 1–22.

Audretsch DB, Feldman MP. 1996. Innovative clusters and the industry life cycle. *Review of Industrial Organization* **11**(2): 253–273.

Audretsch DB, Fritsch M. 1994. The Geography of Firm Births in Germany. *Regional Studies* **28**(768503774): 359–365.

Audretsch DB, Fritsch M. 2002. Growth Regimes over Time and Space. *Regional Studies* **36**(2): 113–124.

Audretsch DB, Keilbach M. 2004. Entrepreneurship and regional growth: An evolutionary interpretation. *Journal of Evolutionary Economics* **14**(5): 605–616.

Auerswald PE, Dani L. 2017. The adaptive life cycle of entrepreneurial ecosystems: the biotechnology cluster. *Small Business Economics*. Small Business Economics **49**(1): 97–117.

Autio E, Nambisan S, Thomas LDW, Wright M. 2018. Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal* **12**(1): 72–95.

Baldwin CY, Clark KB. 2000. *Design Rules: The Power of Modularity*. *Design Rules The Power of Modularity*, 1.

Bansal P, Corley K. 2012. From the Editors Publishing in AMJ - Part 7: What's Different About Qualitative Research ? *Academy of Management Journal* **55**(3): 509–513.

Bansal P, Corley K. 2011. The coming of age for qualitative research: embracing the diversity of qualitative methods. *Academy of Management Journal* **54**(2): 233–237.

Barney JB. 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management* **17**(1): 99–120.

Barney JB. 2001. Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of Management* **27**(6): 643–650.

Barney JB. 2016. *Why Resource-based Theory Must Adopt a Stakeholder Perspective*.

Baron RA. 2007. Behavioral and cognitive factors in entrepreneurship: Entrepreneurs as the active element in new venture creation. *Strategic Entrepreneurship Journal* **1**(1–2): 167–182.

Benneworth P. 2004. In what sense 'regional development?': Entrepreneurship, underdevelopment and strong tradition in the periphery. *Entrepreneurship & Regional Development* **16**(6): 439–458.

Best MH. 2014. Greater Boston′s industrial ecosystem: A manufactory of sectors. *Technovation*. Elsevier : 1–10.

Bettis R, Gambardella A. 2015. Qualitative empirical research in strategic management. *Strategic Management Journal* **36**(5): 637–639.

Beugelsdijk S, Noorderhaven N. 2004. Entrepreneurial attitude and economic growth: A cross-section of 54 regions. *Annals of Regional Science* **38**(2): 199–218.

Bhave MP. 1994. A process model of entrepreneurial venture creation. *Journal of Business*

Venturing **9**(3): 223–242.

Birley S. 1985. The role of networks in the entrepreneurial process. *Journal of Business Venturing* **1**(1): 107–117.

Boschma R. 2015. Towards an Evolutionary Perspective on Regional Resilience. *Regional Studies* **49**(5): 733–751.

Boschma R, Fornahl D. 2011. Cluster Evolution and a Roadmap for Future Research. *Regional Studies* **45**(10): 1295–1298.

Bower JL, Christensen CM. 1995. Disruptive Technologies : Catching the Wave. *Harvard Business Review* (2): 43–54.

Boyd J, Banzhaf S. 2007. What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics* **63**(2–3): 616–626.

Breslow L. 1989. Health status measurement in the evaluation of health promotion. *Medical Care* **27**(3 Suppl): S205–S216.

Brown R, Mason C. 2017. Looking inside the spiky bits: a critical review and conceptualisation of entrepreneurial ecosystems. *Small Business Economics*. Small Business Economics **49**(1): 11–30.

Bruce D, Deskins JA, Hill BC, Rork JC. 2009. (Small) business activity and state economic growth: Does size matter? *Regional Studies* **43**(2): 229–245.

Brüderl J, Preisendörfer P. 1998. Network Support and the Success of Newly Founded Businesses. *Small Business Economics* **10**(3): 213–225.

Brush CG, Greene PG, Hart MM. 2001. From initial idea to unique advantage: The entrepreneurial challenge of constructing a resource base. *Academy of Management Perspectives* **15**(1): 64–80.

Cairns J, McCormick P V., Niederlehner BR. 1993. A proposed framework for developing indicators of ecosystem health. *Hydrobiologia* **263**: 1–44.

Chen K, Kenney M. 2007. Universities/Research Institutes and Regional Innovation Systems: The Cases of Beijing and Shenzhen. *World Development* **35**(6): 1056–1074.

Christensen CM, Bower JL. 1995. Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal* **17**(3): 197–218.

Christopherson S, Michie J, Tyler P. 2010. Regional resilience: Theoretical and empirical perspectives. *Cambridge Journal of Regions, Economy and Society* **3**(1): 3–10.

Cohen B. 2006. Sustainable valley entrepreneurial ecosystems. *Business Strategy and the Environment* **15**(1): 1–14.

Cooke P. 1992. Regional innovation systems: Competitive regulation in the new Europe. *Geoforum* **23**(3): 365–382.

Cooke P. 2001. Regional innovation systems, clusters, and the knowledge economy. *Industrial and corporate change* **10**: 945–974.

Cooke P, Uranga MG, Etxebarria G. 1997. Regional innovation systems: Institutional and organizational dimensions. *Research Policy* **26**(4): 475–491.

Dattée B, Alexy O, Autio E. 2018. Maneuvering in Poor Visibility: How Firms Play the Ecosystem Game when Uncertainty is High. *Academy of Management Journal* **61**(2): 466–498.

Davidsson P. 1991. Continued entrepreneurship: Ability, need, and opportunity as determinants of small firm growth. *Journal of Business Venturing* **6**(6): 405–429.

Delgado M, Porter ME, Stern S. 2010. Clusters and entrepreneurship. *Journal of Economic Geography* **10**(4): 495–518.

Eisenhardt KM. 1989. Building Theories from Case Study Research. *Academy of Management Review* **14**(4): 532–550.

Eisenhardt KM, Graebner ME. 2007. Theory Building From Cases: Opportunities and Challenges. *Academy of Management Journal* **50**(1): 25–32.

Eisingerich AB, Bell SJ, Tracey P. 2010. How can clusters sustain performance? The role of network strength, network openness, and environmental uncertainty. *Research Policy*. Elsevier B.V. **39**(2): 239–253.

Fisher B, Turner RK, Morling P. 2009. Defining and classifying ecosystem services for decision making. *Ecological Economics*. Elsevier B.V. **68**(3): 643–653.

Florida R. 1995. Toward the learning region. *Futures* **27**(5): 527–536.

Fogel DS, Gnyawali DR. 1994. Environments for Entrepreneurship Development: Key Dimensions and Research Implications. *Entrepreneurship Theory and Practice* **18**(4): 43–62.

Forsyth T. 2015. Ecological Functions and Functionings: Towards a Senian Analysis of Ecosystem Services. *Development and Change* **46**(2): 225–246.

Fritsch M, Slavtchev V. 2011. Determinants of the Efficiency of Regional Innovation Systems. *Regional Studies* **45**(7): 905–918.

Garnsey E, Heffernan P. 2005. High-technology Clustering through Spin-out and Attraction : The Cambridge Case. *Regional Studies* **39**(8): 1127–1144.

Garnsey E, Lorenzoni G, Ferriani S. 2008. Speciation through entrepreneurial spin-off: The Acorn-ARM story. *Research Policy* **37**(2): 210–224.

Gartner WB. 1990. What are we talking about when we talk about entrepreneurship? *Journal of Business Venturing* **5**(1): 15–28.

Georgellis Y, Wall HJ. 2000. What makes a region entrepreneurial? Evidence from Britain. *Annals of Regional Science* **34**(3): 385–403.

Gioia D, Corley KG, Hamilton AL. 2012. Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods* **16**(1): 15–31.

Goldstein PZ, Goldstein PZ. 1999. Functional ecosystems and biodiversity buzzwords ecosystem function, ecosystem management, biodiversity, buzzwords, community structure. *Conservation Biology* **13**(2): 247–255.

Goswami K, Mitchell JR, Bhagavatula S. 2018. Accelerator expertise: Understanding the intermediary role of accelerators in the development of the Bangalore entrepreneurial ecosystem. *Strategic Entrepreneurship Journal* **12**(1): 117–150.

Granovetter MS. 1973. The strength of weak ties. *American Journal of Sociology* **78**(6): 1360–1380.

Grime JP. 1997. ECOLOGY: Biodiversity and Ecosystem Function: The Debate Deepens. *Science* **277**(5330): 1260–1261.

De Groot RS, Wilson M a., Boumans RMJ. 2002. A typology for the classification,

description and valuation of ecosystem functions, goods and services. *Ecological Economics* **41**(3): 393–408.

Grossman G, Helpman E. 1996. R & D Spillovers and the Geography of Innovation and Production. *American Economic Review* **86**(3): 630–640.

Groth OJ, Esposito M, Tse T. 2015. What Europe Needs Is an Innovation-Driven Entrepreneurship Ecosystem: Introducing EDIE. *Thunderbird International Business Review* **57**(4): 263–269.

Guba EG, Lincoln YS. 1994. Competing Paradigms in Qualitative Research. *Handbook of Qualitative Research* : 105–117.

Guo M, Shi X, Tietze F. 2017. Ecosystem Strategy in Technology Licensing. In *Academy of Management Proceedings*. Academy of Management, 2017: 16891.

Hannah DP, Eisenhardt KM. 2018. How firms navigate cooperation and competition in nascent ecosystems. *Strategic Management Journal* : 1–30.

Den Hartigh E, Tol M, Visscher W. 2006. The Health Measurement of a Business Ecosystem. In *ECCON 2006 Annual Meeting*, 2783565: 1–39.

He J, Fallah MH. 2011. The typology of technology clusters and its evolution - Evidence from the hi-tech industries. *Technological Forecasting & Social Change*. Elsevier Inc. **78**(6): 945–952.

Hoang H, Antoncic B. 2003. Network-based research in entrepreneurship. *Journal of Business Venturing* **18**(2): 165–187.

Hoang H, Yi A. 2015. Network-based Research in Entrepreneurship: A Decade in Review. *Foundations and Trends® in Entrepreneurship* **11**(1): 1–54.

Hoover EM. 1937. *Location theory and the shoe leather industries*. Harvard University Press: Cambridge, MA.

Hoover EM. 1948. *The location of economic activity*. McGraw-Hill: New York.

Huber M *et al.* 2011. How should we define health? *BMJ (Online)* **343**(7817): 1–3.

Iansiti M, Levien R. 2004a. Keystones and dominators: framing operating and technology strategy in a business ecosystem. *Harvard Business School, Working Paper* : 3–61.

Iansiti M, Levien R. 2004b. Strategy as Ecology. *Harvard Business Review*.

Iansiti M, Richards G. 2006. Information Technology Ecosystem: Structure, Health, and Performance. *Antitrust Bull.*

Isenberg P. 2011. The Entrepreneurship Ecosystem Strategy as a New Paradigm for Economic Policy: Principles for Cultivating Entrepreneurships. *The Babsos Entrepreneurship Ecosystem Project* **1**(781).

Jacobides MG, Cennamo C, Gawer A. 2018. Towards a Theory of Ecosystems. *Strategic Management Journal* : 1–50.

Jacobides MG, Knudsen T, Augier M. 2006. Benefiting from innovation: Value creation, value appropriation and the role of industry architectures. *Research Policy* **35**(8 SPEC. ISS.): 1200–1221.

Jacobides MG, MacDuffie JP, Tae CJ. 2016. Agency, structure, and the dominance of OEMs: Change and stability in the automotive sector. *Strategic Management Journal* **37**(9): 1942–1967.

Jacobs J. 1960. *The Economy of Cities*. Random House: New York.

Jax K, Setälä H. 2005. Function and 'Functioning' in Ecology: What Does It Mean? *Oikos* **111**(3): 641–648.

Johnson P, Duberley J. 2000. *Understanding Management Research: An Introduction to Epistemology*. Sage.

Jonghoon Bae, Wezel FC, Jun Koo. 2011. Cross-Cutting Ties, Organizational Density, and New Firm Formation in the U.s. Biotech Industry, 1994-98. *Academy of Management Journal* **54**(2): 295–311.

Kapoor R, Lee J. 2013. Coordinating and competing in ecosystems: How organizational forms shape new technology investments. *Strategic Management Journal* **296**(July 2012): 274–296.

Krackhardt D. 1995. Entrepreneurial Opportunities in an Entrepreneurial Firm: A Structural Approach. *Entrepreneurship Theory and Practice* **19**(3): 53–69.

Krugman P. 1990. *Increasing returns and economic geography*. *National Bureau of Economic Research*.

Krugman P. 1991a. *Geography and trade*. MIT Press.

Krugman P. 1991b. Increasing returns and economic geography. *Jounral of Political Economy* **99**(3): 483–499.

Kuratko DF, Fisher G, Bloodgood JM, Hornsby JS. 2017. The paradox of new venture legitimation within an entrepreneurial ecosystem. *Small Business Economics*. Small Business Economics **49**(1): 119–140.

Lacher RC, Coats PK, Sharma SC, Fant LF. 1995. A neural network for classifying the financial health of a firm. *European Journal of Operational Research* **85**(1): 53–65.

Langley A, Langley a NN. 1999. Strategies for theorizing from process data. *Academy of Management Review* **691**(4): 691–710.

Langley A, Smallman C, Tsoukas H, Van De Ven AH. 2013. Process studies of change in organization and management: Unveiling temporality, activity, and flow. *Academy of Management Journal* **56**(1): 1–13.

Larson A. 1992. Network Dyads in Entrepreneurial Settings: A Study of the Governance of Exchange Relationships. *Administrative Science Quarterly* **37**(1): 76–104.

Larson JS. 1999. The conceptualization of health. *Medical Care Research and Review : MCRR* **56**(2): 123–136.

Lechner C, Dowling M. 2003. Firm Networks: External Relationships as Sources for the Growth and Competitiveness of Entrepreneurial Firms. *Entrepreneurship & Regional Development* **15**(1): 1–26.

Lichtenstein BMB, Brush CG. 2001. How Do 'Resource Bundles' Develop and Change in New Ventures? A Dynamic Model and Longitudinal Exploration. *Entrepreneurship Theory and Practice* **25**(3): 17–36.

Lieberman MB, Montgomery DB. 1988. First-mover advantages. *Strategic Management Journal*.

Lieberman MB, Montgomery DB. 1998. First-mover (dis) advantages: Retrospective and link with the resource-based view. *Strategic Management Journal* **1125**(June): 1111–1125.

Liu G, Rong K. 2015. The Nature of the Co-Evolutionary Process: Complex Product Development in the Mobile Computing Industry's Business Ecosystem. *Group & Organization Management* **40**(6): 809–842.

Lorenzoni G, Lipparini A. 1999. The leveraging of interfirm relationships as a distinctive organizational capability: A longitudinal study. *Strategic Management Journal* **20**(4): 317–338.

Ma Z. 2002. Social-capital mobilization and income returns to entrepreneurship: The case of return migration in rural China. *Environment and Planning A* **34**(10): 1763–1784.

van Maanen J. 2000. *Qualitative Studies of organisations*. *The Administrative Science Quarterly Series in Organization Theory and Behavior*.

Mack E, Mayer H. 2015. The evolutionary dynamics of entrepreneurial ecosystems. *Urban Studies* **53**(10): 1–16.

Mageau MT, Costanza R, Ulanowicz RE. 1995. The development and initial testing of a quantitative assessment of ecosystem health. *Ecosystem Health*.

Martens ML *et al.* 2007. Do the Stories They Tell Get Them the Money They Need ? The Role of Entrepreneurial Narratives in Resource Acquisition. *Academy of Management Perspectives* **50**(5): 1107–1132.

Martin R, Sunley P. 2011. Conceptualizing Cluster Evolution: Beyond the Life Cycle Model? *Regional Studies* **45**(10): 1299–1318.

Martin R, Sunley P. 2015. On the notion of regional economic resilience: Conceptualization and explanation. *Journal of Economic Geography* **15**(1): 1–42.

Mason C, Brown R. 2014. Entrepreneurial ecosystems and growth oriented entrepreneurship. *Final Report to OECD* **30**(1): 77–102.

Mason C, Harvey C. 2013. Entrepreneurship: Contexts, opportunities and processes. *Business History* **55**(1): 1–8.

Mason CM, Harrison RT. 2006. After the exit: Acquisitions, entrepreneurial recycling and regional economic development. *Regional Studies* **40**(1): 55–73.

McCann P. 2013. *Modern urban and regional economics*. Oxford University Press.

Meccheri N, Pelloni G. 2006. Rural entrepreneurs and institutional assistance: An empirical study from mountainous Italy. *Entrepreneurship & Regional Development* **18**(5): 371–392.

Menzel MP, Fornahl D. 2009. Cluster life cycles-dimensions and rationales of cluster evolution. *Industrial and Corporate Change* **19**(1): 205–238.

Meyer DR. 1983. Emergence of the American manufacturing belt: an interpretation. *Journal of Historical Geography* **9**(2): 145–174.

Miles MB, Huberman AM. 1994. *Qualitative data analysis: An expanded sourcebook*. Sage.

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-being: Synthesis*. *Island Press*. Washington, DC, 5.

Mokhatab Rafiei F, Manzari SM, Bostanian S. 2011. Financial health prediction models using artificial neural networks, genetic algorithm and multivariate discriminant analysis: Iranian evidence. *Expert Systems with Applications*. Elsevier Ltd **38**(8): 10210–10217.

Moore JF. 1993. Predators and prey: a new ecology of competition. *Harvard Business Review* **71**(3): 75–86.

Moore JF. 1996. *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems*. *Leadership*.

Moore JF. 2004. Business ecosystems and the view from the firm. *Antitrust Bull.* **51**: 31–75.

Müller S. 2016. A progress review of entrepreneurship and regional development: What are the remaining gaps? *European Planning Studies* **4313**(April): 1–26.

Myrdal G. 1957. *Economic Theory and Under-developed Regions*. Dark-worth: London.

Nambisan S, Baron RA. 2013. Entrepreneurship in Innovation Ecosystems: Entrepreneurs' Self-Regulatory Processes and Their Implications for New Venture Success. *Entrepreneurship Theory and Practice* **37**(5): 1071–1097.

Neck HM, Meyer GD, Cohen B, Corbett AC. 2004. An entrepreneurial system view of new venture creation. *Journal of Small Business Management* **42**(2): 190–208.

O'Gorman C, Kautonen M. 2004. Policies to promote new knowledge-intensive industrial agglomerations. *Entrepreneurship & Regional Development* **16**(6): 459–479.

Odum EP. 1985. Trends Expected in Stressed Ecosystems. *BioScience* **35**(7): 419–422.

Phaal R, O'Sullivan E, Routley M, Ford S, Probert D. 2011. A framework for mapping industrial emergence. *Technological Forecasting & Social Change*. Elsevier Inc. **78**(2): 217–230.

Pike A, Rodríguez-Pose A, Tomaney J. 2007. What Kind of Local and Regional Development and for Whom? *Regional Studies* **41**(9): 1253–1269.

Pitelis C. 2012. Clusters, entrepreneurial ecosystem co-creation, and appropriability: A conceptual framework. *Industrial and Corporate Change* **21**(6): 1359–1388.

Porter ME. 1985. *Competitive Advantage:Creating and sustaining superior performance*. *New York*, 15.

Porter ME. 1990. *The Competitiveness of Nations*. Free Press: New York.

Porter ME. 1991. Towards a dynamic theory of strategy. *Strategic Management Journal* **12**(S2): 95–117.

Porter ME. 1996. Competitive advantage, agglomeration economies, and regional policy. *International Regional Science Review* **19**(1–2): 85.

Porter ME. 2000. Location, Competition, and Economic Development: Local Clusters in a Global Economy. *Economic Development Quarterly* **14**(1): 15–34.

Pred AR. 1966. *The Spatial Dynamics of U.S. Urban-Industrial Growth, 1800- 1914: Interpretive and Theoretical Essay*. MIT Press: Cambridge, MA.

Qian H, Acs ZJ, Stough RR. 2013. Regional systems of entrepreneurship: The nexus of human capital, knowledge and new firm formation. *Journal of Economic Geography* **13**(4): 559–587.

Rapport DJ. 1989. What constitutes ecosystem health? *Perspectives in Biology and Medicine* **33**(1): 120–132.

Rapport DJ. 1992. Evaluating ecosystem health. *Journal of Aquatic Ecosystem Health* **1**: 15–24.

Rapport DJ, Costanza R, McMichael AJ. 1999. Assessing ecosystem health. *Trends in*

Ecology & Evolution **13**(10): 397–402.

Rapport DJ, Regier HA, Hutchinson TC. 1985. Ecosystem behavior under stress. *American Naturalist* **125**(5): 617–640.

Rindova VP, Yeow A, Martins LL, Faraj S. 2012. Partnering portfolios, value-creation logics, and growth trajectories: A comparison of Yahoo and Google (1995 to 2007). *Strategic Entrepreneurship Journal* **6**(2): 133–151.

Risser PG. 1995. Biodiversity and Ecosystem Function. *Conservation Biology* **9**(4): 742–746.

Roberts PW. 2001. Innovation and firm-level persistent profitability: a Schumpeterian framework. *Managerial and Decision Economics* **22**(4–5): 239–250.

Rong K, Hu G, Lin Y, Shi Y, Guo L. 2015. Understanding business ecosystem using a 6C framework in Internet-of-Things-based sectors. *International Journal of Production Economics*. Elsevier **159**: 41–55.

Rong K, Ren Q, Shi X. 2018. The determinants of network effects: Evidence from online games business ecosystems. *Technological Forecasting & Social Change*. Elsevier **134**(9): 45–60.

Rong K, Shi Y. 2014. *Business Ecosystems Constructs, Configurations, and the Nurturing Process*. Palgrave Macmillan.

Saxenian A. 1983. The Genesis of Silicon Valley. *Built Environment* **9**(1): 7–17.

Saxenian A. 1990. Regional Networks and the Resurgence of Silicon Valley. *California Management Review* **33**(1): 89–112.

Saxenian A. 1991. The origins and dynamics of production networks in Silicon Valley. *Research Policy* **20**(5): 423–437.

Saxenian A. 1996. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128. Harvard University Press*.

Schaeffer DJ, Herricks EE, Kerster HW. 1988. Ecosystem health: I. Measuring ecosystem health. *Environmental Management* **12**: 445–455.

Schulze E-D, Mooney H a. 1994. Biodiversity and Ecosystem Function. *Science* **335**(January): 521.

Schumpeter JA. 1934. *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. Transaction publishers, 55.

Seppelt R, Dormann CF, Eppink F V., Lautenbach S, Schmidt S. 2011. A quantitative review of ecosystem service studies: Approaches, shortcomings and the road ahead. *Journal of Applied Ecology* **48**(3): 630–636.

Shane S, Venkataraman S. 2000. The Promise of Entrepreneurship As a Field of Research. *Academy of Management Review* **25**(1): 217–226.

Shi X, Liang X. 2015. Understanding Latecomer Strategy from a Business Ecosystem Perspective. In *Academy of Management Proceedings*, 2015: 18506.

Shi X, Liang X, Shao X, Shi Y. 2016. Innovation Ecosystem Governance: a Typology of Generic Strategies for Managing Complementors. In *Academy of Management Proceedings*. Academy of Management, 2016: 11918.

Shi X, Shi Y. 2016. 'Conceptualizing Entrepreneurial Ecosystems: Definition, Configurations and Health'. In *Academy of Management Proceedings*. Academy of Management, 2016:

11074.

Shi X, Shi Y. 2017. Unpacking Entrepreneurial Ecosystem Health. *Academy of Management Proceedings* **2017**(1): 16215.

Siggelkow N. 2007. Persuasion with Case Studies. *Academy of Management Journal* **50**(1): 20–24.

Simmie J, Martin R. 2010. The economic resilience of regions: Towards an evolutionary approach. *Cambridge Journal of Regions, Economy and Society* **3**(1): 27–43.

Spigel B. 2017. The Relational Organization of Entrepreneurial Ecosystems. *Entrepreneurship Theory and Practice* **41**(1): 49–72.

Spigel B, Harrison R. 2018. Toward a process theory of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal* **12**(1): 151–168.

Spilling OR. 1996. The entrepreneurial system: On entrepreneurship in the context of a mega-event. *Journal of Business Research* **36**(1): 91–103.

Starr JA, Macmillan IC. 1990. Resource Cooptation Via Social Contracting: Resource Acquisition Strategies for New Ventures. *Strategic Management Journal* **11**(4): 79–92.

Storper M. 1995. The Resurgence of Regional Economies, Ten Years Later. *European Urban and Regional Studies* **2**(3): 191–221.

Stuart TE, Hybels RC. 1999. Interorganizational Endorsements and the Performance of Entrepreneurial Ventures Ha Hoang. *Administrative Science Quarterly* **44**(2): 315–349.

Tallman S, Jenkins M, Henry N, Pinch S. 2004. Knowledge, clusters, and competitive advantage. *Academy of Management Review* **29**(2): 258–271.

Tamásy C. 2006. Determinants of regional entrepreneurship dynamics in contemporary Germany: A conceptual and empirical analysis. *Regional Studies* **40**(4): 365–384.

Tansley AG. 1935. The Use and Abuse of Vegetational Concepts and Terms Author (s): A . G . Tansley. *Ecology* **16**(3): 284–307.

Taylor SJ, Bogdan R. 1985. Introduction to Qualitative Research Methods: The Search for Meaning. *Nursing Research* **34**: 266.

Teece DJ. 1986. Profiting from technological innovation : Implications for integration , collaboration , licensing and public policy. *Research policy* **15**(February): 285–305.

Teece DJ. 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal* **28**(13): 1319–1350.

The Lancet. 2009. What is health? The ability to adapt. *The Lancet*. Elsevier Ltd **373**(9666): 781.

Thompson TA, Purdy JM, Ventresca MJ. 2018. How entrepreneurial ecosystems take form: Evidence from social impact initiatives in Seattle. *Strategic Entrepreneurship Journal* **12**(1): 96–116.

Tödtling F, Trippl M. 2005. One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy* **34**: 1203–1219.

Ucbasaran D, Westhead P, Wright M. 2001. The Focus of Entrepreneurial Research: Contextual and Process Issues. *Entrepreneurship Theory and Practice* **25**(4): 57–80.

Van de Ven AH, Poole MS. 1995. Explaining development and change. *Academy of*

Management Review **20**(3): 510–540.

Van De Ven H. 1993. The development of an infrastructure for entrepreneurship. *Journal of Business Venturing* **8**(3): 211–230.

Vissa B, Aya S. Chacar. 2009. Leveraging ties: the contingent value of entrepreneurial teams' external advice networks on Indian software venture performance. *Strategic Management Journal* **30**(11): 1179–1191.

Wareham J, Fox PB, Cano Giner JL. 2014. Technology Ecosystem Governance. *Organization Science* **25**(4): 1195–1215.

Wernerfelt B. 1984. A Resource-based View of the Firm. *Strategic Management Journal* **5**(June 1982): 171–180.

WHO. 1946. World Health Organization. In *Minutes of the Technical Preparatory Committee for the International Health Conference*: 3–18.

Yang ZR, Platt MB, Platt HD. 1999. Probabilistic Neural Networks in Bankruptcy Prediction. *Journal of Business Research* **44**(2): 67–74.

Yin RK. 1989. *Case Study Research: Design and Methods (Applied Social Research Methods)*. *Newbury Park CA Sage*.

Yin RK. 2009. *Case Study Research: Design and Methods*. *Essential Guide to Qualitative Methods in Organizational Research*, 5.

Zahra S a., Nambisan S. 2012. Entrepreneurship and strategic thinking in business ecosystems. *Business Horizons*. 'Kelley School of Business, Indiana University' **55**(3): 219–229.

Zahra SA. 2016. Portrait of a Research Pioneer: Andrew Van de Ven. *Strategic Entrepreneurship Journal* **10**(4): 413–429.

Zhang G, Hu MY, Patuwo BE, Indro DC. 1999. Artificial neural networks in bankruptcy prediction: general framework and cross-validation analysis. *European Journal of Operational Research* **116**(1): 16–32.

Zhang J, Soh P hooi, Wong P kam. 2010. Entrepreneurial resource acquisition through indirect ties: Compensatory effects of prior knowledge. *Journal of Management* **36**(2): 511–536.

Zhou W. 2011. Regional deregulation and entrepreneurial growth in china's transition economy. *Entrepreneurship & Regional Development* **23**(9–10): 853–876.

Zhu S, Shi Y. 2010. Shanzhai manufacturing – an alternative innovation phenomenon in China: Its value chain and implications for Chinese science and technology policies. *Journal of Science and Technology Policy in China* **1**(1): 29–49.